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FINAL WORK PLAN PRE-REMEDIAL DESIGN INVESTIGATION NSY PORTSMOUTH VA
1/27/2000
CDM FEDERAL PROGRAMS CORPORATION

**Miscellaneous Military/Civil HTRW Projects
For U.S. Army Corps of Engineers Baltimore District**

**Final
Work Plan**

**Pre-Remedial Design Investigation
Atlantic Wood Industries, Inc. Superfund Site
Portsmouth, Virginia**

**Contract No. DACA31-96-D-0014
Delivery Order No. 015**

**Prepared for:
U.S. Army Corps of Engineers
Baltimore District**

27 January 2000

Prepared by:

CDM Federal Programs Corporation
A subsidiary of Camp Dresser & McKee Inc.

{

- AWI1 PROPOS
- EPIC PROPOS
- MOV

PROJECT STATUS MEETING AGENDA

Pre-Remedial Design Investigation of Atlantic Wood Industries Superfund Site

3 February 2000

✓ Approach for AWI OU 1 PRDI (Final Work Plan)

✓ Schedule for PRDI Activities

* ✓ PRDI Coordination Approaches

- Weekly Site Briefings with Weekly Activity List
- EPA Conference Calls
- Contact Information

✓ AWI DNAPL Work Plan Addendum - *Scoping Now*

- Monitoring Well Sampling
- FLUTE Well Evaluation

✓ Adjacent Property Work Plan Addenda

- Navy Property
- Other Properties

• OU 2 Planning (GW)
- NNSH PROPERTY (?)

Other Topics

- *MANY SURVEILING ON NNSH PROPERTY NEEDS TO BE DONE SOON.*
- *CAOAT HUMAN RISK*

✓ - *NNSH WORKTOWN DATA*

• *BP REPORT TO CDM*

2/3/00

- FILL ON WEST SIDE MAX OF 2 1/2 FEET NEAR SPJA PLANT.
 - ORDINANCE AVOIDANCE / METALS CLEARING
- DOING PERIMETER FIRST

- * UTILITIES CLEARANCE ON \$ OFF NAVY PROPERTY (RESPOND BY 2/10/00)
 - ACOE ~~AS~~ WANTS NAVY TO CLEAR THE SITE
 - USE DRUGS AND THEN SWEEP
 - WAO SIGNS?
 - TALK CALAHAN IN ROICC

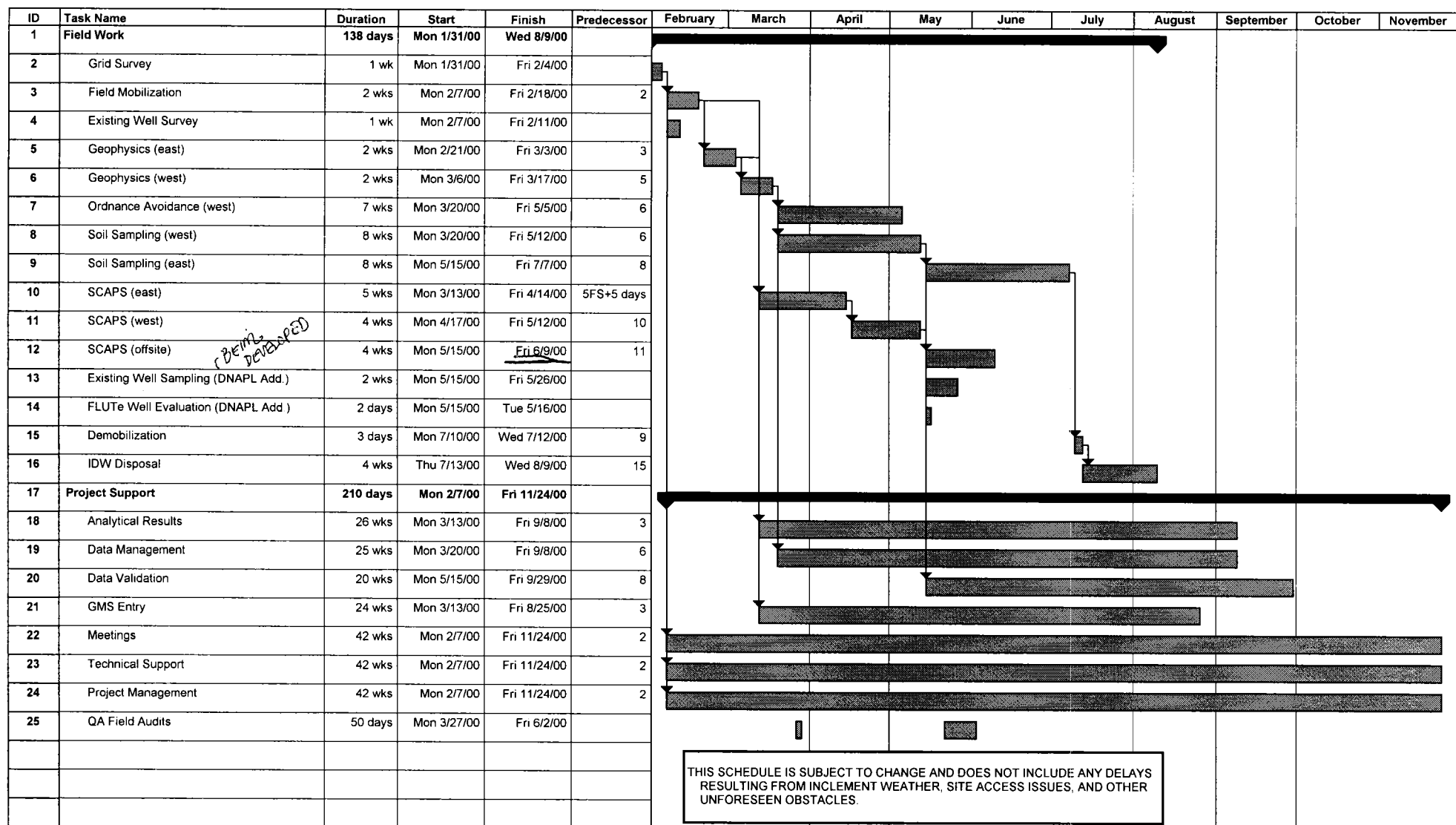
- WEEKLY BRIEFING RE: ACTIVITIES TO BE ISSUED. NNGM IMPACTS TO BE HIGHLIGHTED.
 - WHAT'S PLANNED / WHAT HAPPENED 1 WEEK INCREMENTS

- FLUTE WELLS (2 LOCATIONS) / 2 INCH DIA.
 - BOTTLE SCRAP ON EAST SIDE

FLUTE

↳ FLEX. LINE UNDERGROUND TECHNOLOGY. (KARL KELLER)
(POLYURETHANE / TETRAON)
VITON

2/3/00



AWI Superfund Site
PRDI Project Schedule as of January 30, 2000

Task

Progress

Milestone



Summary

Rolled Up Task

Rolled Up Milestone



Rolled Up Progress

External Tasks

Project Summary



Split

Rolled Up Split



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Feb 3, 2000 CoE Office

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MISCELLANEOUS MILITARY/CIVIL HTRW PROJECTS
FOR
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

**FINAL
FIELD SAMPLING PLAN**

**PRE-REMEDIAL DESIGN INVESTIGATION
ATLANTIC WOOD INDUSTRIES, INC. SUPERFUND SITE
PORTSMOUTH, VIRGINIA**

CONTRACT NO. DACA31-96-D-0014
DELIVERY ORDER NO. 015

27 January 2000

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

Prepared by:

CDM FEDERAL PROGRAMS CORPORATION
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LIST OF ABBREVIATIONS AND ACRONYMS

APR	Air Purifying Respirator
ASTM	American Society for Testing and Materials
AWI	Atlantic Wood Industries
BaPEq	Benzo(a)pyrene Equivalents
CCA	Chromium Copper Arsenate
CCQC	Contractor Chemical Quality Control
CDM Federal	CDM Federal Programs Corporation
CHSM	Corporate Health and Safety Manager
CIH	Certified Industrial Hygienist
CQC	Contract Quality Control
DOT	U.S. Department of Transportation
DNAPL	Dense Non-Aqueous Phase Liquid
DPT	Direct Push Technology
DCQCR	Daily Chemical Quality Control Report
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Plan
ft	foot, feet
GPR	Ground Penetrating Radar
HCL	Hydrochloric Acid
HNO ₃	Nitric Acid
HTW	Hazardous and Toxic Waste
ID	Inside Diameter
IDW	Investigation-Derived Waste
LIF	Laser-Induced Fluorescence
LNAPL	Light Non-Aqueous Phase Liquid
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priorities List
OVM	Organic Vapor Monitor
PAHs	Polynuclear Aromatic Hydrocarbons
PCP	Pentachlorophenol
PM	Project Manager
PPE	Personal Protective Equipment
PRDI	Pre-Remedial Design Investigation
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAD	Quality Assurance Director
QAPP	Quality Assurance Project Plan
QC	Quality Control

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

RI	Remedial Investigation
ROD	Record of Decision
RRU	Remedial Response Unit
SC	Site Coordinator
SCAPS	Site Characterization and Analysis Penetrometer System
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SOW	Statement of Work
SSHP	Site Safety and Health Plan
TAL	Target Analyte List
TCDD	Tetrachlorodibenzodioxins
TCDF	Tetrachlorodibenzofurans
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
UXO	Unexploded Ordnance
VEPCO	Virginia Electric and Power Company
VOC	Volatile Organic Compound
°C	degrees Centigrade

1.0 PROJECT DESCRIPTION

CDM Federal Programs Corporation (CDM Federal) has been contracted by the U.S. Army Corps of Engineers, Baltimore District (USACE) under Prime Contract No. DACA31-96-D-0014 to conduct Pre-Remedial Design Investigation (PRDI) activities at the Atlantic Wood Industries (AWI), Inc. Superfund Site in Portsmouth, Virginia. These activities will be conducted in accordance with the Scope of Work (SOW) entitled "Pre-Remedial Design Investigation, A/E Field Investigation Oversight, Atlantic Wood Industries, Inc. Superfund Site, Portsmouth, Virginia" dated 18 December 1998.

The purpose of the PRDI is to define the extent of soil and sediment contamination above the water table that exceeds the 1995 Record of Decision (ROD) cleanup levels, and the extent of mobile dense non-aqueous phase liquid (DNAPL) below the water table. The PRDI is being conducted in order that a remedial design can be prepared to meet the remedies selected in the ROD.

Specific activities to be performed in the PRDI include surface geophysics, ordnance avoidance, soil and sediment sampling above the water table, subsurface investigation to map subsurface stratigraphy and delineate DNAPLs using a Site Characterization and Analysis Penetrometer System (SCAPS), soil sampling for verification of SCAPS data, and a condition survey of existing monitoring wells.

This Work Plan has been prepared to address the requirements of USACE document EM 200-1-3 "Requirements for the Preparation of Sampling and Analysis Plans" dated 1 September 1994. The Work Plan consists of a Field Sampling Plan (FSP) (Section 1), a Quality Assurance Project Plan (QAPP) (Section 2), and a Site Safety and Health Plan (SSHP) (Section 3). The format of the FSP follows the general outline provided in EM 200-1-3, and sections that are not relevant to this PRDI have been omitted.

1.1 SITE HISTORY AND CONTAMINANTS

The AWI site occupies approximately 47.5 acres of land on the industrialized waterfront area of Portsmouth, Virginia (Figure 1-1). The site is bounded to the north by Elm Avenue and the U.S. Norfolk Naval Shipyard facilities, and to the south by the south annex of the U.S. Norfolk Naval Shipyard and land occupied by the Portsmouth City School Board. The site is bounded on the east by the Southern Branch of the Elizabeth River, and a Virginia Electric Power Company (VEPCO) right-of-way is located to the west. The site is split into eastern and western portions by the Norfolk and Portsmouth Beltline R.R. and Burtons Point Road. Inactive wood processing operations and wood storage areas are located on the eastern portion of the site, and the storage of treated and untreated wood occurred on the west side of the site.

The original AWI plant was constructed in 1926 and has been used for various purposes during its history, including possible coal tar refinery, creosote treating plant, pentachlorophenol (PCP) treating plant, and storage of treated lumber. According to site records, treatment of wood with chromated copper arsenate (CCA) was never performed at this site; however, storage of CCA treated wood did occur. Prior to 1926, the site was undeveloped except for possibly a saw mill. The historic shoreline on the east side of the site has been filled over the years. Between 1978 and 1986, a significant amount of fill material was added to this general area. Wood preserving operations ceased in the 1990's, and most of the processing buildings and structures are still present onsite. The western portion of the site is currently used for manufacturing post tension concrete materials.

Navy operations in the vicinity of the AWI site have affected AWI property. Potential impacts have not been fully assessed by previous AWI investigations. Navy operations on the southern edge of the eastern half of the AWI property involved land disposal of acetylene sludge (also referred to as waste lime), which appears to have flowed onto AWI property.

A significant portion of the western half of the AWI property was leased to the Navy during World War II. The Navy is reported to have filled low lying areas with fill material in order to use the property as a storage area. No investigation of the fill material was conducted during the Remedial Investigation (RI), because AWI was unaware of the history of that area at the time the RI was conducted. Recent investigation of the fill material has unearthed buried ordnance-like items. These items, however, have been determined to be inactive.

1.1.1 REGULATORY HISTORY

On 23 July 1987, AWI entered into an Administrative Consent Order with EPA Region III whereby AWI would perform initial cleanup actions and perform an RI and Feasibility Study (FS) for the site. The site was formally listed on the National Priorities List (NPL) on 15 February 1990. The AWI site has been segregated by EPA into three operable units, Operable Unit 1 (Soil, Sediment, and DNAPL), Operable Unit 2 (Groundwater), and Operable Unit 3 (River/Offsite areas). The ROD for Operable Unit 1 was issued in September 1995. The cleanup levels identified in the ROD are presented in Table 1-1.

An initial cleanup action has been performed by AWI. Based on the results of the RI, it was evident that hazardous substances had migrated into the soil surrounding the storm sewer on the northeast portion of the site along Elm Avenue, and to the inlet sediments where this sewer discharges. Under EPA oversight, AWI hired a contractor in March 1995 to clean and install a new liner within the sewer system. In addition, in May 1995, approximately 660 cubic yards of contaminated sediments were excavated from the inlet area, stored onsite, and later disposed offsite.

1.1.2 SITE GEOLOGY

The AWI site is located in the Atlantic Coastal Plain Physiographic Province. The geology consists of a wedge of unconsolidated units that dips and thickens to the east and extends

approximately 20 miles east to the Atlantic Ocean. These unconsolidated units overlie basement rocks which consist of Triassic sedimentary rock and Paleozoic igneous and metamorphic rocks. The depth to the bedrock in the site area is approximately 2000 ft.

Three lithologic zones and two water-bearing zones have been identified beneath the AWI site as follows:

- Upper Water-Bearing Zone (Columbia Aquifer) - The uppermost soil is a brown to gray, organic-rich mixture of clayey silt and fine to medium sand that ranges in thickness from 18 to 23 feet. This layer is continuous across the site. Depth to groundwater within the Columbia Aquifer at the AWI site is typically 2 to 4 feet below ground surface.
- Yorktown Clay - Underlying the Columbia Aquifer is a layer of gray clay which acts as a semi-confining unit. The clay is often silty and contains shell fragments. During the RI, three borings were drilled through the Yorktown Clay and into the underlying Yorktown Aquifer indicating the thickness of the clay ranges between 8 and 27 feet at the site. Based on the RI data, the Yorktown Clay may be present over portions of the site. However, the full extent of the clay layer has not been determined.
- Lower Water-Bearing Zone (Yorktown Aquifer) - The Yorktown Clay overlies a fine to medium to coarse grained sand zone known as the Yorktown Aquifer. This aquifer is considered to be confined or semi-confined by the overlying Yorktown Clay and is a major source of groundwater for industrial users in the area. As of 1980, the nearest reported centers of pumping were located approximately three miles south of the site, on the east side of the Southern Branch of the Elizabeth River and approximately four to five miles to the east.

Geologic cross sections from the Remedial Investigation (Keystone Environmental Resources Inc., January 1992) are presented in Figures 1-2, 1-3, and 1-4.

1.2 SUMMARY OF EXISTING SITE DATA

The majority of the RI field work was completed in 1988 and 1989, and the RI report was prepared in January 1992. The RI activities included collecting samples from surface and subsurface soils, onsite and Inlet Area sediments, Elizabeth River sediments, and groundwater. Because the focus of this Work Plan is to perform sampling that is relevant to the pre-Remedial Design Investigation for Operable Unit 1, discussions of the RI are being limited to surface and subsurface soil sampling, onsite and Inlet Area sediment sampling, and locations of DNAPL.

The AWI site was segregated into 9 principal study areas as shown in Figure 1-5. These areas were reportedly selected based on a review of aerial photographs and interviews with AWI employees regarding past plant practices and operations. The RI grid areas included:

- Areas 1 to 4 - Wood Storage Yards
- Areas 5 to 7 - Wood Treatment Area
- Area 8 - Material Pile
- Area 9 - Historic Disposal Area

The soil sampling locations were randomly selected from 50 ft grids inside the RI grid areas. Shallow soil samples were manually collected at 0 to 6 inch and 12 to 18 inch depths, and deeper soil samples (typically to approximately 20 ft) were collected using hollow stem auger drilling methods.

Sediment samples were collected from three of the onsite storm sewer drainage ditches and the Inlet Area on the northeast portion of the site. Sampling depths were from 0 to 6 inches. The presence and apparent thickness of DNAPL that had accumulated within the onsite

monitoring wells was measured using an oil/water interface probe during groundwater sampling in 1989.

Results of surface soil, subsurface soils, sediments and DNAPL investigations are as follows:

- Surface Soils. Total Polynuclear Aromatic Hydrocarbons (PAHs) were detected at 84 locations at concentrations up to 13,254 milligrams per kilogram (mg/kg). PCP was detected at 85 locations at concentrations up to 970 mg/kg. Arsenic, chromium, and copper were detected at 32 locations at concentrations up to 1000 mg/kg, 73 mg/kg, and 9,780 mg/kg, respectively. Zinc was detected in 77 locations at concentrations up to 20,400 mg/kg. Volatile organic compounds (VOCs) were detected in 12 locations with concentrations of benzene up to 30 micrograms per kilogram (ug/kg), toluene up to 97 ug/kg, chlorobenzene up to 8 ug/kg, ethylbenzene up to 96 ug/kg, styrene up to 85 ug/kg, and xylene up to 1,400 ug/kg. Dioxins and furans were detected in 10 locations at concentrations up to 4,660 ug/kg and 374 ug/kg, respectively.
- Subsurface Soils. Total PAHs were detected at 65 locations at concentrations up to 73,448 mg/kg. PCP was detected at 65 locations at concentrations up to 290 mg/kg. Arsenic, chromium, and copper were detected at 65 locations at concentrations up to 445 mg/kg, 31 mg/kg, and 2,180 mg/kg, respectively. Zinc was detected at 65 locations at concentrations up to 2,990 mg/kg. VOCs were detected at 27 locations at concentrations of benzene up to 140 ug/kg, toluene up to 290 ug/kg, ethylbenzene up to 770 ug/kg, styrene up to 560 ug/kg, and xylene up to 3,700 ug/kg. Dioxins and furans were detected in 3 locations at concentrations up to 4,800 ug/kg and 1,220 ug/kg, respectively.
- Onsite Sediments. Maximum detected concentrations of total PAHs and PCP on the AWI property were 3,118 mg/kg and 12 mg/kg, respectively. Maximum detected concentrations of arsenic, chromium, copper, and zinc were 364 mg/kg,

63 mg/kg, 1,350 mg/kg, and 1,890 mg/kg, respectively. Inlet Area sediment samples indicated that PCP was not detected, and total PAHs were identified at up to 38,437 mg/kg (prior to the removal action). Following the removal action, the maximum total PAH level in the Inlet Area sediment was 2,323 mg/kg. Metals were not analyzed for in the Inlet Area sediment samples.

- DNAPL. The presence of distinct phases of hydrocarbon fluids was determined with an oil/water interface probe during RI groundwater sampling. DNAPLs were observed in seven of the onsite monitoring wells measured. Only a sinking phase (DNAPL) was detected and no floating light non-aqueous phase liquid (LNAPL) was observed. A DNAPL sample was also collected from MW-117 and analyzed for PAHs and dioxins/furans. High PAH concentrations of up to 6.4% for an individual constituent were identified. No PCP or dioxins/furans were detected.

In general, PAHs and PCP were detected in the 9 areas of the site in surface and subsurface soil samples. The highest levels of PAHs were detected in subsurface samples Areas 5, 6 and 7 (Wood Treatment Area) and Area 8 (Material Pile). The highest levels of PCP and dioxins were detected in soil samples in Area 9 (Historic Disposal Area).

No soil samples contained detectable levels of 2,3,7,8-tetrachlorodibenzodioxins (TCDD), while 2 samples contained detectable levels of 2,3,7,8-tetrachlorodibenzofurans (TCDF). The hexa-, hepta-, and octa-isomers of dioxins and furans, which are less toxic than TCDD and TCDF, were the most frequently detected isomers.

The highest level of total PAHs in AWI property sediment samples was present in the Southeastern Ditch, with levels up to 3,118 mg/kg, and the highest level of PCP was present in the Storm Water Ditch with concentrations up to 12 mg/kg. The highest concentration of arsenic, copper, and zinc was in the Southeastern Ditch, with maximum concentrations of 364 mg/kg, 1,350 mg/kg, and 1,890 mg/kg, respectively. The highest concentration of chromium was detected in the Storm Water Ditch, with concentrations up to 63 mg/kg.

1.3 DATA GAPS

A review of the above results indicates that soil, sediment, and DNAPL contamination (Operable Unit 1) has not been fully defined at the AWI site. As a result, further investigation is required to determine the lateral and vertical extent of contamination for use in the remedial design.

Data gaps to be addressed in the PRDI relate to the source areas and further investigation of contamination migration on the site. Investigation activities will address the following data gaps:

- The boundaries of the waste and debris disposal areas.
- The lateral and vertical extent of contamination in the surface and subsurface soils above the water table.
- The presence or absence of sediment contamination in the Western Ditch, Storm Water Ditch, and Southeastern Ditch (Inlet Area excluded) to a depth of 6 inches. The Inlet Area is expected to be addressed as part of Operable Unit 3.
- The extent of dioxins/furans contamination in sediments (dioxins/furans sediment data is not currently available).
- The location and extent of mobile DNAPLs below the water table.
- An identification of soil characteristics below the water table and the extent of the Yorktown clay confining unit.
- The current condition of existing monitoring wells.

1.4 SITE SPECIFIC SAMPLING AND ANALYSIS PROBLEMS

Documentation of the location of potentially buried ordnance-like items is not available.

Therefore, the entire Navy leased area will be considered to contain potentially live ordnance-like items. A procedure for ordnance avoidance is presented in Section 4.3.2.1.1 to protect personnel and equipment.

Metal slag has been unearthed in the fill from the Navy leased area, and debris has been disposed on site, which may hinder or damage sampling equipment. Therefore, portions of the study area will be pre-drilled with a direct push rig (with a contingency for a hollow stem auger) to prevent damage to the SCAPS probe.

The surface above the acetylene sludge is reported to be unstable, with viscous sludge material underlying the surface. As a result, the surface may not support the weight of sampling equipment or vehicles (e.g., SCAPS rig). In such cases, sampling locations may need to be adjusted or abandoned, and will be evaluated during the field investigation.

TABLE 1-1
CLEANUP LEVELS IDENTIFIED IN ROD (mg/kg)

Area	BaPEq ^a	Total PAHs	PCP	Arsenic	Copper	Zinc	Dioxins/ Furans
RRU1 - Area 1 Wood Treatment Area East	11	100	3 ^b	150	390	410	0.001
RRU1 - Area 2 Wood Treatment Area West	10	100	2 ^b	76	390	410	0.001
RRU1 - Area 3 Historic Disposal Area	8	100	3 ^b	150	390	410	0.001
RRU1 - Area 4 Wood Storage Yard	6	100	3 ^b	131	390	410	0.001
RRU5 - Area 9 Acetylene Sludge Area	8	100	3 ^b	150	390	410	0.001
Sediments by Area: RRU2 - Area 5, 6, 7 RRU4 - Area 8 (All Sediment Areas)	n/a	25	0.4 ^c	85	390	270	0.001

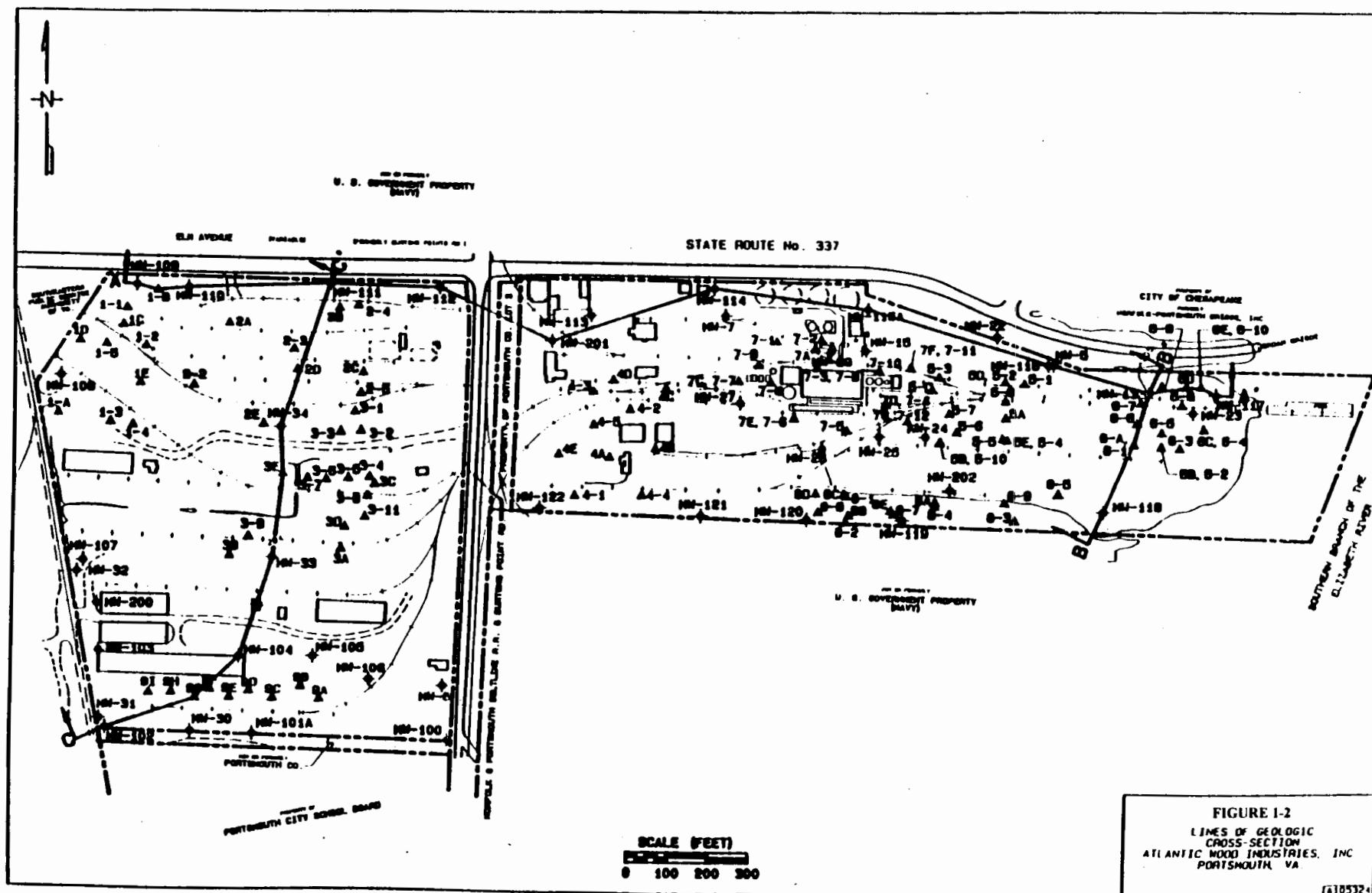
Notes:

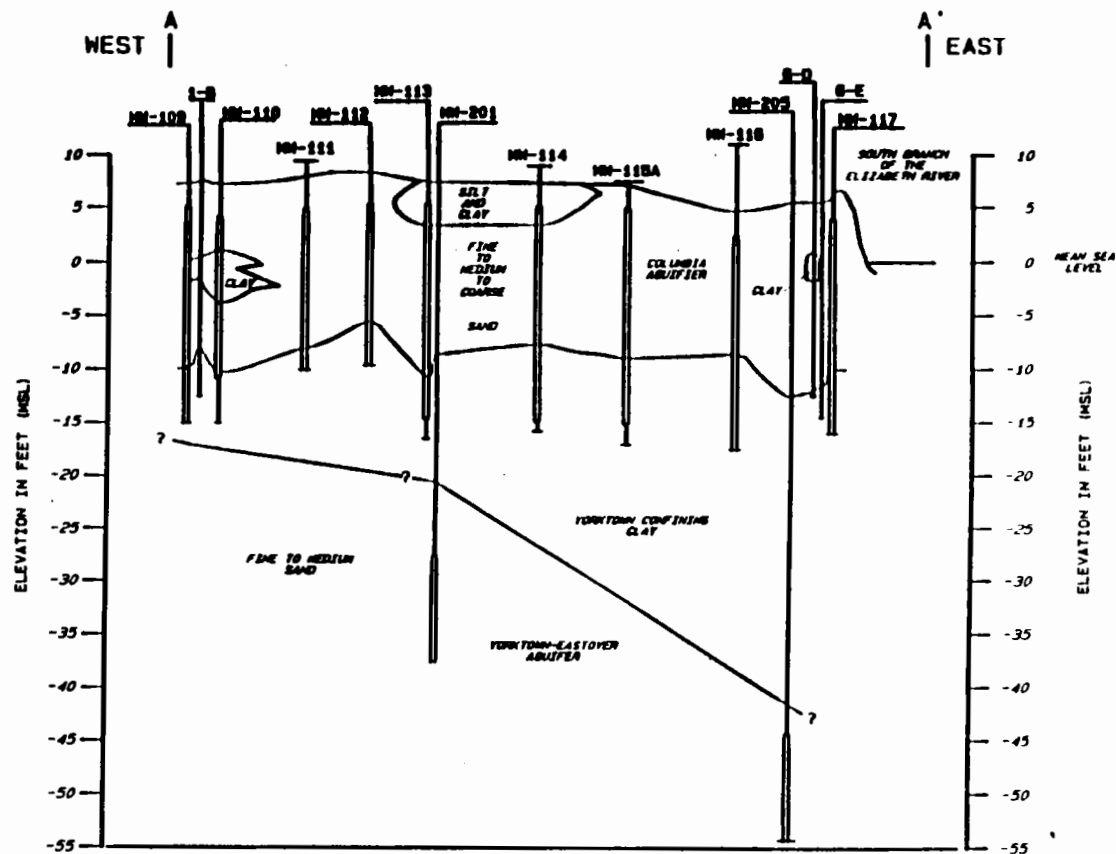
^aBaPEq = benzo(a)pyrene equivalents (represents carcinogenic PAHs)

^bChemical and biological monitoring of sediments must be performed if post-remedial concentrations of PCP exceed 0.4 mg/kg in site soils.

^cThe sediment cleanup level for PCP (0.4 mg/kg) is not expected to be achievable using engineered land treatment, and excavated sediments shall be backfilled with clean sediments. Sediments that are treated to achieve the soil cleanup level for PCP (2 to 3 mg/kg) shall be backfilled as soil.

RRU - Remedial Response Unit.





LEGEND

- MM-111 - WELL DESIGNATION
- ┆ - DEPTH OF BORING
- ▮ - MONITORING WELL SCREENED INTERVAL

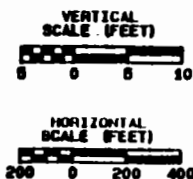
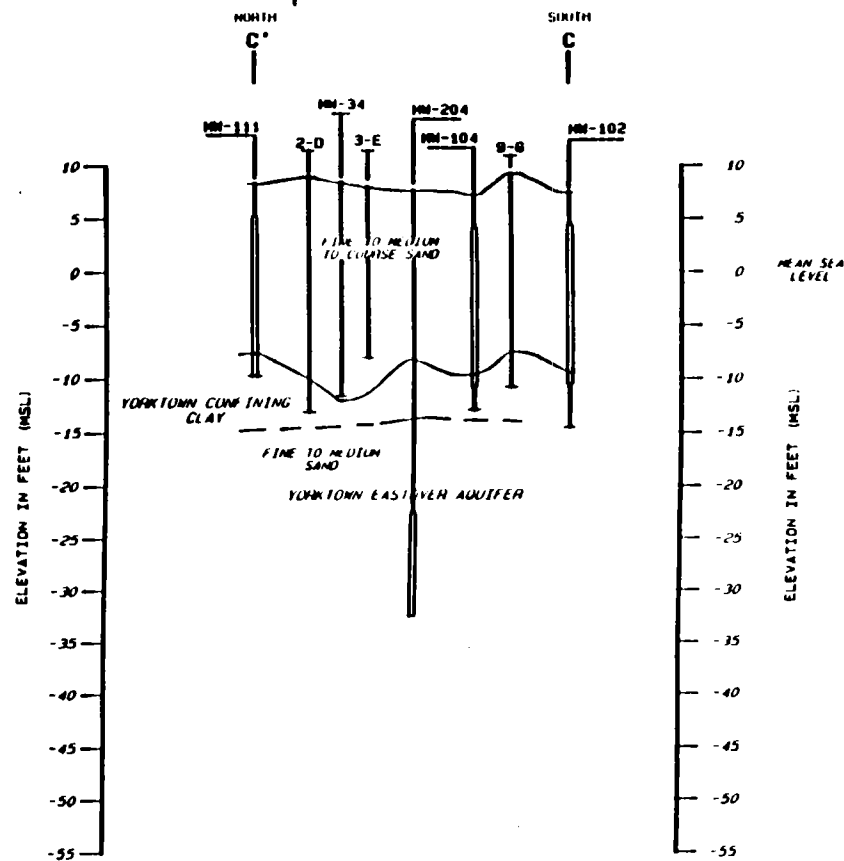
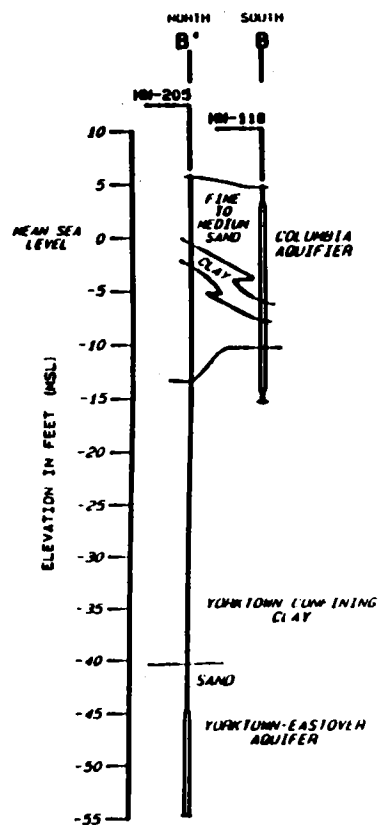


FIGURE I-3
GEOLOGIC CROSS SECTION A-A'
ATLANTIC WOOD INDUSTRIES, INC.
PORTSMOUTH, VA

08/01/91

6102339



LEGEND

- MM-111 - WELL DESIGNATION
- I - DEPTH OF BORING
- - MONITORING WELL SCREENED INTERVAL

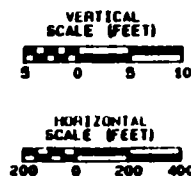
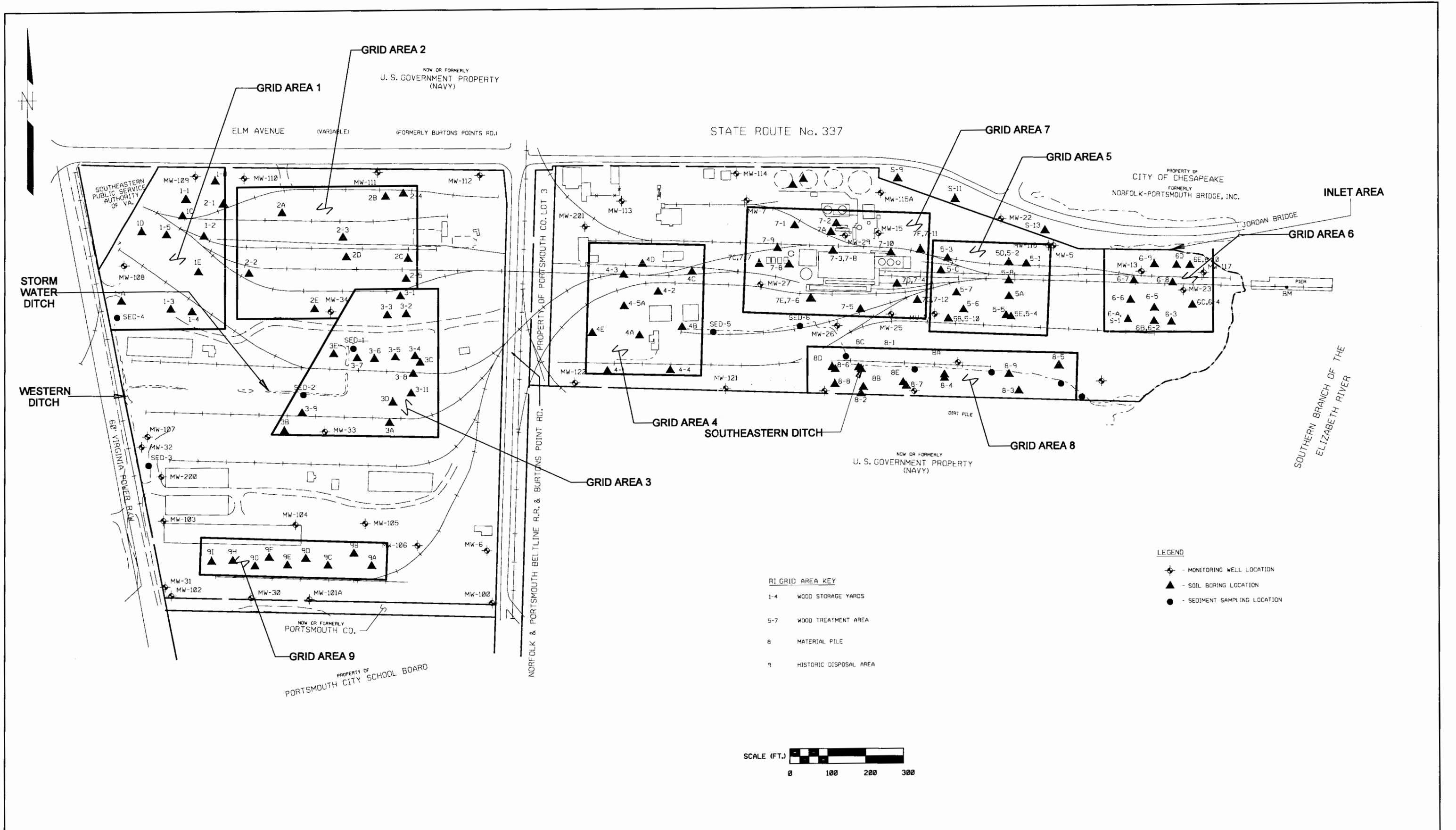


FIGURE 1-4
GEOLOGIC CROSS SECTION
B-B' and C-C'
ATLANTIC MOND INDUSTRIES, INC.
PORTSMOUTH, VA



Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA SOIL AND SEDIMENT SAMPLING LOCATIONS FROM PREVIOUS RI	Dwg. No.
Checked By:	Date:		FIGURE 1-5
Approved By:	JAN. 2000		

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 U.S. ARMY CORPS OF ENGINEERS

The single point of contact for this contract is Mr. Edward Yakuchev, who is the Design Manager for the USACE Baltimore District, telephone number (410) 962-6727.

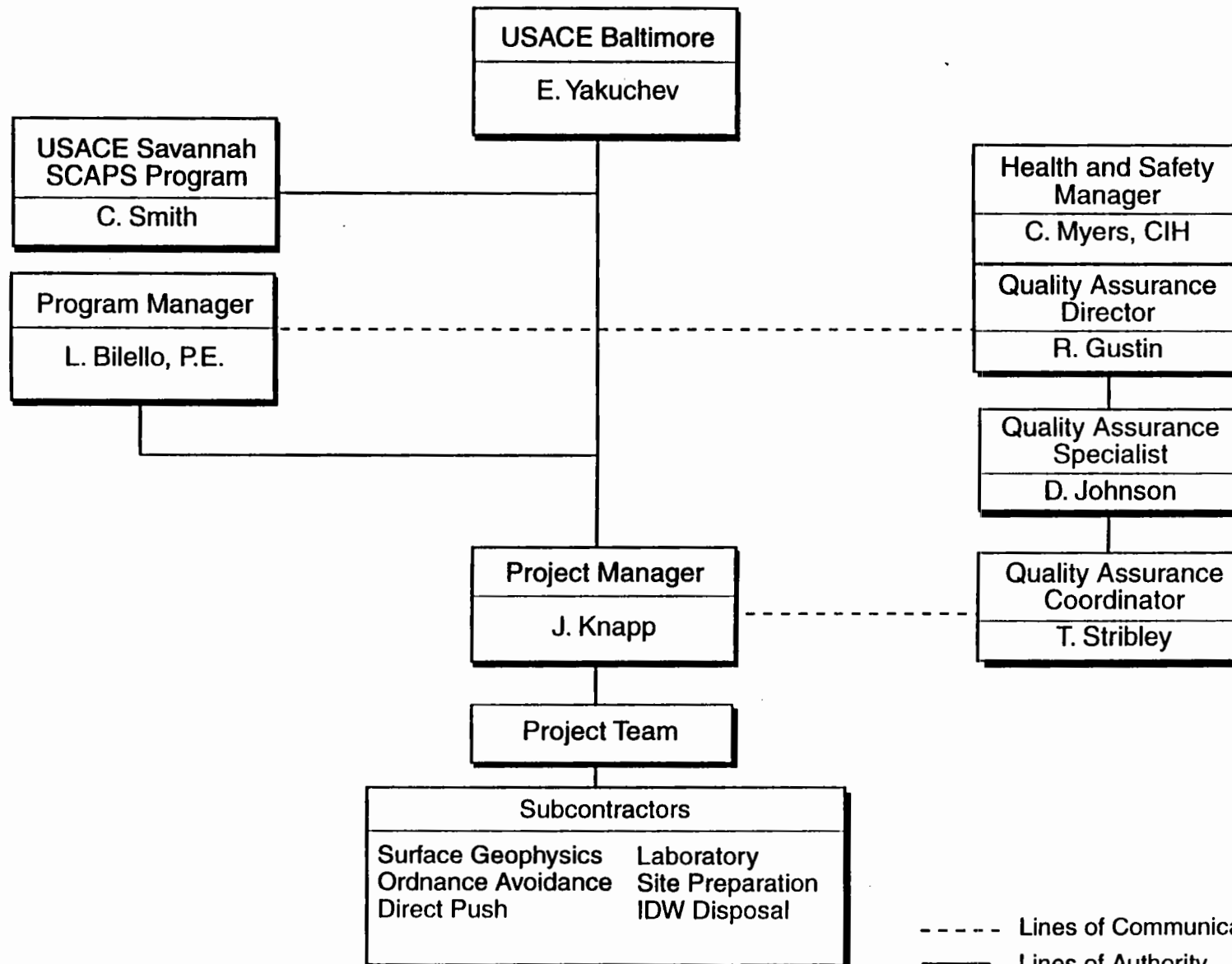
2.2 CDM FEDERAL PROGRAMS CORPORATION

The project will be staffed by personnel from CDM Federal and subcontractors. Figure 2-1 depicts the CDM Federal project personnel and organization. Mr. Louis Bilello, P.E. is the Program Manager and has ultimate responsibility for all matters related to this project. Ms. Joan Knapp is the Project Manager (PM) and is responsible for implementing all procedures and requirements of this Work Plan. Daily project planning, subcontractor coordination, and field coordination will be provided by Mr. Richard Doucette, P.G., Site Coordinator (SC). The SC will report directly to the PM on a day-to-day basis. The SC is responsible for overseeing the implementation of all technical field activities and coordinating overall logistics with AWI while in the field.

The Corporate Health and Safety Manager (CHSM) is a Certified Industrial Hygienist (CIH). Mr. Charles Myers, CIH, will be responsible for overall health and safety issues. The Site Health and Safety Officer (SHSO) for the site will be Mr. Dean Costello. The CHSM exercises his responsibilities at the project level through the SHSOs. The SHSOs remain onsite during all field activities and report to the PM regarding any health and safety violations or discrepancies.

The project Quality Assurance Director (QAD), Ms. RoseMary Gustin, will be responsible for overall quality assurance (QA) management. Mr. Dave Johnson serves as the Quality Assurance Specialist (QA Specialist) and reports to the QA Director. Mr. Todd Stribley serves as the

Quality Assurance Coordinator (QA Coordinator) for the site. Primary responsibility for implementing the quality control (QC) measures of this Work Plan rests with the PM. The QA/QC organization is discussed in detail in Section 2.0 of the QAPP.



3.0 SCOPE AND OBJECTIVES

The overall purpose of the PRDI is to define the extent of soil and sediment contamination above the water table that exceeds the 1995 ROD cleanup levels, and the extent of mobile DNAPL below the water table. The PRDI is being conducted in order that a remedial design can be prepared to meet the remedies selected in the ROD.

The specific objectives of the PRDI are to identify:

- The boundaries of the waste and debris disposal areas.
- The lateral and vertical extent of contamination in the surface and subsurface soils above the water table.
- The presence or absence of sediment contamination in the Western Ditch, Storm Water ditch, and Southeastern Ditch (Inlet Area excluded) to a depth of 6 inches.
- The extent of dioxins/furans contamination in sediments (dioxins/furans sediment data is not currently available).
- The location and extent of mobile DNAPLs below the water table.
- An identification of soil characteristics below the water table and the extent of the Yorktown clay confining unit.
- The current condition of existing monitoring wells.

Several investigation field activities will be performed during the PRDI. Listed below is a summary of these activities:

- Surface Geophysical Survey
- Ordnance Avoidance
- Surface and Subsurface Soil Sampling
- Sediment Sampling
- SCAPS Investigation
- Well Condition Survey and Water Level Measurement
- IDW Management and Disposal

The current PRDI scope does not include an investigation of the Inlet Area, adjacent properties, groundwater underlying the site, and river sediments along the shoreline. It is anticipated that this PRDI will be expanded to include an investigation of the adjacent properties and groundwater underlying the site. The Inlet Area and river sediments will be investigated as part of Operable Unit 3.

4.0 FIELD ACTIVITIES

Field activities associated with the PRDI have been planned to further assess the nature and extent of contamination in soil and sediment above the water table and to locate mobile DNAPL below the water table. Information obtained from the investigation will be used to delineate the extent of surface and subsurface contamination to support the preparation of the Remedial Design. Figure 4-1 identifies the areas of investigation at the AWI site, and provided below is a list of field activities and associated sections of the FSP:

<u>Activity</u>	<u>Section</u>
Surface Geophysics	4.1
Ordnance Avoidance	4.3 & 4.4
Well Condition Survey	4.2
Soil Sampling	4.3
SCAPS Support & Verification Sampling	4.3
Sediment Sampling	4.4

This section presents the methods and procedures for performing field activities. Appendix B contains the following CDM Federal Standard Operating Procedures (SOPs) and Equipment Procedures (EPs) which will be followed:

<u>SOP Number</u>	<u>SOP Title</u>
1-1	Surface Water and Sediment/Sludge Sampling
1-2	Sample Custody
1-3	Surface Soil Sampling
1-4	Subsurface Soil Sampling
1-6	Water Level Measurement
1-10	Field Measurement of Organic Vapors
2-5	Packaging and Shipping Environmental Samples
2-6	Guide to Handling Investigation-Derived Waste
3-1	Geoprobe Sampling

3-3	Magnetometer Survey
3-5	Lithologic Logging
4-1	Field Logbook Content and Control
4-2	Photographic Documentation of Field Activities
4-5	Field Decontamination at Nonradioactive Sites

EP Number

EP Title

C.2	OVM/Data Logger, Model 580B
C.3	HNU Model PI-101/Photoionization Meter

The procedures presented in this section are brief summaries of the referenced SOPs and provide additional site-specific detail which may not be discussed in the SOPs. The site-specific procedures described below will be followed during this investigation. Section 5.0 contains information on sample identification codes for each sample and media type. The SSHP should be consulted to determine health and safety protocols for performing site work.

The following equipment has been identified and will be used for environmental monitoring, multi-media sampling, health and safety monitoring, equipment and personnel decontamination, and general field operations (Table 4-1). Equipment acceptance, handling, maintenance and calibration procedures for environmental monitoring instruments are summarized below:

- Field equipment and supplies will be used throughout the different areas of the site as field work progresses. The SC will ensure that no areal cross-contamination occurs as a result of using the same field equipment in different areas of the site.
- All field equipment providing measurements of a chemical or physical parameter will have available, onsite, the approved manufacturers' instructions for operation,

calibration, and maintenance. These instructions or manuals will be updated as necessary.

- All field instruments will have physical or chemical standards appropriate for the accurate operation of the equipment used on a routine basis to verify the accuracy of the measurements for each instrument. All physical or chemical standards will be traceable to known, recognized standards. Calibration standards will be traceable to the National Institute of Standards and Technology (NIST) or other nationally recognized sources whenever possible. All of the standards will be documented as to origin, date of receipt, and date of expiration, if applicable. This information will be recorded and maintained in the field logbook or appropriate form.
- All field instruments will be inspected and calibrated prior to use. More than one calibration per day may be necessary, depending on field conditions. All field personnel performing daily calibration will document the findings of the calibration event on the Equipment Calibration Form (included in Appendix C). Non-compliance with the findings of the calibration criteria will dictate removal of the equipment from use until sufficient remedial measures return the equipment to calibration compliance. This non-compliance will be reported to the last operator so the results of measurements obtained since the prior calibration will be reviewed for consistency with anticipated results. The non-compliance will also be reported in the daily chemical quality control report (DCQCR). If prior results are in question, they will be reported to the PM.
- All field instruments will be protected from exposure to potentially-contaminated materials and will be wiped clean with a damp cloth prior to removal from the site boundaries.

Sample Containers

All sample containers and any preservatives used to collect and contain samples designated for chemical analyses will be provided by the subcontractor laboratory. All sample containers will be laboratory precleaned and traceable to the laboratory that performed the cleaning. Sample containers will not be cleaned or rinsed in the field. Analytical results from trip blanks will be one method by which the quality of sample containers will be assessed to ensure that containers are not producing false results.

Utility Clearances

Utility clearances will be coordinated by CDM Federal through contact with Miss Utility, AWI Staff, and Navy staff, before any subsurface drilling or sampling activities will be performed. Proposed locations will be staked, and clearances will be obtained to ensure that no underground utilities exist. If underground utilities are present, any proposed locations in question will be moved to avoid the utility.

4.1 SURFACE GEOPHYSICS

4.1.1 RATIONALE

Surface geophysical methods will be employed over the entire AWI site for the purpose of locating disposal areas, buried debris (e.g., wood, metal, and sludge), underground utilities, and other buried objects which might hinder sampling activities. The geophysical survey will also assist in soil sample placement and other field decisions associated with data collection. An electromagnetic (EM) terrain conductivity meter, a total field magnetometer, and a ground penetrating radar instrument (GPR) may be used to collect the geophysical data. Selection of geophysical instruments will be dependent on how the instruments respond to the existing site conditions (e.g., presence of post-tension reinforced concrete material stored above ground).

4.1.1.1 Method

The EM provides a composite conductivity value for subsurface materials. The instrument reading is influenced only by those materials between, and within the approximate plane of, the transmitter and receiver coils. The EM survey will identify anomalies in conductivity due to the soil type, porosity, permeability, and metallic objects (both ferrous and nonferrous).

The magnetometer measures the earth's total magnetic field strength at a discrete point several feet above the surface. Subtle variations in this field may be caused by the natural distribution of iron oxides in the underlying soil. More significant changes in the magnetic field intensity will be caused by the presence of buried metal objects composed of steel, iron or ferrous alloys. The response of the magnetometer is a function of the object's depth and mass. It is anticipated that the magnetic data will be useful in providing approximate depth and mass of any buried ferrous materials.

Although it is not expected that the EM survey will reach the approximate depth of the Yorktown confining layer, the data may be compared to the information provided from the SCAPS rig. If the correlation appears to be accurate, the information may then be used to fill in data gaps throughout the site.

The GPR utilizes a transmitting antenna to radiate short pulses of high-frequency radio waves into the ground and the receiving antenna records variations in the reflected return signal. This technique may be used to verify the results of the EM and magnetometer surveys.

4.1.1.2 Study Area Definition and Measurement Spacing

The surface geophysical survey will cover the entire AWI site. A grid system will be set up on the site from which instrument readings will be collected. It is anticipated that the EM and magnetometer surveys will be completed using 10 foot line spacing, with readings collected every 2.5 feet. This spacing will be sufficient to satisfy the requirements of the investigation.

The GPR survey will only be performed in locations where it is necessary to confirm the results of the EM and magnetometer surveys. Several surface geophysics grid points will be surveyed in order to position the grid relative to the Virginia State Plane Coordinate System.

4.1.2 PROCEDURES

4.1.2.1 Equipment

The following equipment may be utilized by the surface geophysics subcontractor to conduct the geophysical survey:

- Terrain Conductivity Meter (EM-31, EM-38, or comparable equipment)
- Magnetometer (Geometrics G-858 or comparable equipment)
- GPR System (Pulse EKKO 100, or comparable equipment)
- Compass
- Survey Stakes/Flags
- Fiberglass Measuring Tape
- Logbook

4.1.2.2 Preliminary Method Testing and Termination Procedures

The surface geophysical methods proposed for this investigation have proven to be effective in delineating waste boundaries provided the wastes are located within 4 feet of the surface and the magnitude of surficial interferences such as fences, power lines, vehicles, metallic debris and other phenomena do not mask subsurface data.

On the east side of the AWI site only a small amount of surface debris is located within the survey area, with the exception of the rail tracks present onsite. Therefore, surficial interferences are not expected to preclude the application of the proposed geophysical equipment except in the areas within a few feet of the rail tracks. A reconnaissance will be conducted using both the EM

and magnetometer to determine the approximate areal extent and physical magnitude of anomalies associated with buried material at the site.

The situation is more complex on the west side of the AWI site, particularly where the new post-tension concrete operation is located. Significant surficial interferences exist in this area. Therefore, limited data may be collected in portions of the site immediately adjacent to steel reinforced concrete material.

4.1.2.3 Instrument Calibration and Quality Control Procedures

The EM, magnetometer, and GPR meters will be initially calibrated by the manufacturer. CDM Federal will verify the date of the most recent instrument calibration from the manufacturer or vendor which provides the equipment.

The surface geophysics subcontractor will perform the required calibration and functional checks (e.g., battery phasing, sensitivity, and instrument tuning) as specified in the instrument operating manuals. Field calibration and functional checks will be conducted in an area free of surface and subsurface disturbances (i.e., a background area).

The instrument operator will also check to ensure that he or she is not a source of interference. Some items, such as watches, belt buckles, etc. can affect the instrument reading. To check for this type of interference, the operator will identify a background area and collect instrument readings while standing at various orientations about the instrument. If the readings collected in this manner indicate that interference is present, the operator will check for and remove potential sources of interference.

4.1.2.4 Field Progress/Interpretation Reporting

During all phases of the survey, significant observations and decisions will be entered in the field logbook. Logbook entries may include justification for deviations in the grid spacing, if any, and

the location of any particularly large anomalies that might warrant special attention. Formal data interpretation will be presented in two interim field reports and one final report.

4.1.2.5 Measurement Point/Grid Surveying

Instrument readings will be collected digitally by the instrument. Readings may be collected between the grid nodes in areas where the terrain conductivity or magnetic field gradients are steep. This will ensure more accurate characterization and presentation of anomalous areas.

4.1.2.6 Data Interpretation

A quantitative analysis of the data will be performed and presented in the form of a contour map. Contour maps are generated by plotting the x, y and z coordinates of the survey data, where x and y represent a physical location on the survey grid, and z represents the total field intensity (instrument reading) at that location. Two field reports will be prepared by the surface geophysics subcontractor (west side and east side) so that the data will be available during the soil, sediment, and SCAPS investigation. Also, a final report will be prepared that provides additional detail on investigation activities and a summary of results.

4.2 WELL CONDITION SURVEY

4.2.1 RATIONALE

The well condition survey for the 43 groundwater monitoring wells at AWI will consist of collecting water level readings, measuring well depths, collecting oil/water interface probe readings to detect DNAPLs, and completing a well condition survey form. This information will provide a better understanding of the hydrogeologic conditions, the extent of mobile DNAPL, and the usability of the existing wells for future data collection and DNAPL remediation. The

well condition survey will also determine if well screens contain excessive silt or if the screen interval is open. Monitoring well locations are identified on Figure 4-1.

4.2.2 WATER LEVEL AND DNAPL MEASUREMENT

The electric tape method with an oil/water interface probe will be utilized for taking water level measurements and depths to DNAPL (if present). Procedures will be in accordance with CDM Federal SOP 1-6, provided in Appendix B. The following is a summary of the method to be used:

- The probe and line will be decontaminated prior to and after each use following the procedures outlined in Section 4.2.3
- The probe will be lowered slowly into the well until the water surface or oil/water interface is indicated. The measurements will be taken from the surveyed measurement point on the well casing (this point will be on the top of the well casing, not the protective casing). If no measurement point is indicated, the measurement will be taken from the north edge of the well casing.
- A second reading will be taken to confirm the initial reading. Following the water level and oil/water interface measurements, the total depth of the well will be measured.
- Independent measurements of static water levels using the same tape should agree within plus or minus (\pm) 0.01 ft for depths of less than 200 ft.
- A solid PVC rod (1 $\frac{5}{8}$ -inch diameter) will be placed into the well and lowered to the well bottom to determine the plumbness of the well.

- The well condition survey form provided in Appendix C will be completed. Information to be recorded includes date and time of measurement, well identification number, well casing material, well diameter, stickup or flush mount construction, depth to water, total well depth, thickness of DNAPL (if any), plumbness of well, and general comments.
- To limit the effect of tidal changes on measurements, all wells will be opened and allowed time for pressure stabilization before measurements are made. CDM Federal personnel will then measure the depth to water in each well as rapidly as possible to minimize tidal effects. Decontamination material and equipment will be carried from well to well.

4.2.2.1 Documentation

Personnel will record daily activities in a field logbook. The logbook will contain specific information about the day's activities as described in CDM Federal SOP 4-1 (Appendix B) including date, names and affiliation of all onsite personnel, description of all activities, problems or delays encountered, and equipment used during field activities. Any deviations from this FSP will be stated. Also, the well condition survey form will be completed as described above.

4.2.3 DECONTAMINATION PROCEDURES

All reusable equipment used for measurements in wells will be decontaminated in accordance with CDM Federal SOP 4-5 (Appendix B) before coming into contact with any sample. The decontamination procedure will match the degree of contamination on the measuring tool. Decontamination of equipment will occur either at the stationary decontamination area or at portable decontamination areas set-up at sampling locations. All items that will come into contact with potentially contaminated media will be decontaminated prior to use. If

decontaminated items are not immediately used, they will be covered with aluminum foil. All decontamination episodes and deviations from the decontamination procedures will be recorded in the field logbook. The general decontamination procedures for the equipment being used are described below:

- Water-level indicators and oil/water interface probes, and other equipment will be cleaned with Liquinox and tap water, rinsed thoroughly with tap water and then rinsed with deionized water. Items not immediately used will be wrapped in aluminum foil.

4.3 SURFACE AND SUBSURFACE SOIL

4.3.1 RATIONALE

Surface and subsurface soil samples will be collected in the unsaturated zone at 167 locations on the west side and 230 locations on the east side to determine the lateral and vertical extent of contamination in the study area. Table 4-2 provides a summary of the environmental sampling activities, and Figures 4-2 to 4-5 identify the soil sample locations which are segregated by analyses to be performed. Direct push technology (DPT) will be used to collect the soil samples, except for in the Navy leased areas where ordnance avoidance activities and hand augering techniques are planned. In the event that refusal frequently occurs during DPT soil sampling due to excessive obstructions (e.g., Navy leased area fill, or native material such as rocks), then split-spoon sampling may be performed using hollow stem auger drilling methods.

The SCAPS investigation to be performed by USACE will collect soil characterization data at 300 locations using a laser induced fluorescence (LIF) probe to identify the locations of mobile DNAPL. Also, a cone penetrometer will be used to identify the types of soil present and the extent and thickness of the Yorktown clay confining unit. The SCAPS sample locations are identified in Figure 4-6. Verification soil samples will be performed using the DPT rig to collect

soil samples in the unsaturated zone and saturated zone at 20 locations to verify lithology and the presence of potential contamination detected by the SCAPS. Also, DPT borings (with a contingency to use hollow stem auger drilling) will be made to pre-drill SCAPS sampling locations where buried debris may be encountered that could potentially damage the SCAPS probe. In areas with detectable DNAPL, the SCAPS and DPT rigs will not penetrate the Yorktown confining unit. These locations will also be grouted immediately through the rods to insure proper abandonment.

4.3.1.1 Boring Locations

Boring locations were selected based on existing data available from previous field investigations and a review of historic aerial photographs.

4.3.1.1.1 Soil Samples in the Unsaturated Zone

The purpose of the soil sampling investigation is to define the lateral and vertical extent of contamination above the water table that exceeds ROD cleanup levels (or risk-based screening levels, as appropriate). To meet this objective, a systematic grid sampling pattern was selected to cover the AWI site, given that much of the site was used for treating, storing, or disposing of wood and waste generated in the process. In known highly contaminated areas that will be targeted for remedial action, the grid will focus on the perimeters, with a closer spacing pattern than in the interiors of the known highly contaminated areas. If the PRDI indicates areas of contamination not previously identified, it may be necessary to conduct additional closely spaced sampling (at a later date) to identify the perimeters of the contaminated areas.

The grid spacing is dependent on the types of analyses to be performed, as shown in Figures 4-2 to 4-6, and summarized below. Figure 4-8 lists all the sampling locations and all the analyses.

- **Define VOCs Contamination:** Collect soil samples on 200 ft grid across the site to identify any potential VOC sources of contamination impacting

groundwater, samples collected at one depth (2-4 ft) in subsurface just above the water table where least amount of volatilization is expected to have occurred. VOC samples will be collected via EnCore™ samplers. In addition to the EnCore™ samplers, additional volume will be collected as a dry weight sample. This additional volume will be collected using standard VOC soil sampling methods. (See SOPs 1-4 and 3-1.)

- **Define PAHs and PCP Contamination:** Collect soil samples on 50-ft grid at perimeters in areas of known contamination (RI Grid areas 4, 5, 6, 7, 8, and 9) and newly identified areas (open dump areas, dark material area, tar distillation area, and tank area) and 100-ft grid elsewhere. Sample at the surface (0-0.5 ft) and subsurface just above the water table (2-4 ft). (See SOPs 1-3, 1-4, and 3-1.)
- **Define Metals Contamination:** Collect soil samples on 50-ft grid in sand blasting grit area (along AWI/Navy border) where major source of metals contamination is located, and 100-ft grid elsewhere. Sample at the surface (0-0.5 ft) and subsurface between the surface and the water table (0.5-2 ft). (See SOPs 1-3, 1-4, and 3-1.)
- **Define Dioxins/Furans Contamination:** Collect soil samples on 100-ft grid in historic disposal area (in location of the highest dioxin/furan levels at AWI site), and 200-ft grid elsewhere. Sample at the surface (0-0.5 ft) and subsurface between the surface and the water table (0.5-2 ft). (See SOPs 1-3, 1-4, and 3-1.)

4.3.1.1.2 SCAPS Investigation

The purpose of the SCAPS investigation to be performed by USACE is to determine the extent of mobile DNAPL below the water table, and to identify the extent and thickness of the Yorktown clay confining unit at the site. This will be accomplished by collecting SCAPS data

on a 100-ft grid pattern across the site (236 locations). In addition, a 25% contingency (59 locations) is expected in order to tighten up the grid in areas where mobile DNAPL is identified. The locations of the additional SCAPS points will be selected after reviewing the SCAPS data.

The SCAPS sample locations are presented in Figure 4-6 and summarized below. The sampling depths were selected as either 25 ft (to reach the top of the Yorktown clay which is approximately 20 ft below grade), or 50 ft (to reach the bottom of the Yorktown clay which is approximately 45 ft below grade).

- Initial Grid Locations. Collect SCAPS data to 25 ft in 75% of the initial locations (177 locations), and to 50 ft in 25% of the locations (59 locations).
- Contingency Locations. The locations and depths will be chosen based on review of the data from the initial SCAPS samples.

4.3.1.1.3 SCAPS Support

Soil borings will be made to pre-drill SCAPS sampling locations in the acetylene sludge, historical disposal, and open dump areas where buried debris is anticipated. The SCAPS sample locations are shown in Figure 4-6.

4.3.1.1.4 SCAPS Verification Samples

Soil samples for SCAPS verification will be collected at 20 locations adjacent to selected SCAPS sampling locations. The sampling locations will be selected by USACE based on the results of the SCAPS investigation. A DPT rig (with a contingency to use hollow stem auger drilling) will be used to collect soil samples to 25 ft in 15 locations, and to 50 ft in 5 locations. In areas with detectable DNAPL, DPT rig soil sampling will not penetrate the Yorktown confining unit. These locations will be grouted immediately through the rods to insure proper abandonment.

CDM Federal will visually log the samples according to the Unified Soil Classification System (USCS) (see SOP 3-5). The samples will also be visually logged to observe if high LIF probe readings correlate with visible DNAPL. Five soil samples will be collected for offsite laboratory analysis of soil characteristics (soil classification, particle size distribution, liquid limit, and plasticity index). Also, soil samples from 4 depths at each of the 20 locations will be collected for offsite analysis of PAHs and PCP to correlate PAH and PCP levels to LIF readings, and TPH (diesel and gasoline range) to evaluate the effects of interference from petroleum compounds at the site to LIF probe readings. See SOPs 1-4 and 3-1 for sampling methods. The Site Coordinator will work with the USACE SCAPS rig team to evaluate the verification results in relation to the LIF readings at comparable locations and depths and to develop a correlation. LIF readings which provide DNAPL levels as relative counts will be correlated to the PAH analytical data by verifying whether areas of high LIF probe readings have correspondingly high PAH laboratory results. Depths of the four samples from each location will be selected to correlate to two relative high and two relative low LIF readings. The correlation methodology has not been specified by the USACE SCAPS team at this point, and will be defined in the field by USACE based upon the team's previous experience and AWI site results.

4.3.1.2 Discrete/Composite Soil Sampling Requirement

Soil samples for VOC analysis will be collected first as discrete, grab samples. This will minimize the loss of volatiles during sampling. The remainder of the necessary soil sample volume from the same location will then be placed into a separate stainless steel mixing bowl and homogenized. This will provide a homogeneous sample for these analyses.

4.3.1.3 Sample Collection and Field and Laboratory Analysis

Direct push soil sampling techniques have been selected since they will allow for the collection of subsurface soil samples in a rapid manner, and are relatively simple to operate compared to the use of drill rigs. Also, direct push sampling is an effective means of collecting subsurface soil

samples in unconsolidated soils at the shallow depths targeted for this field investigation. In the Navy leased areas, hand augering in combination with ordnance avoidance will be employed. In the event that refusal frequently occurs during DPT soil sampling due to excessive obstructions (e.g., Navy leased area fill, or native material such as rocks), then split-spoon sampling may be performed using hollow stem auger drilling methods.

SCAPS sampling techniques have been selected as the preferred method by USACE for detection of mobile DNAPL and for classifying subsurface soils at a large number of locations.

CDM Federal will utilize an offsite laboratory for soil sample analysis. Analytical parameters were selected based on existing knowledge of the types of contamination present in the study area. The primary concern is from the past waste handling and disposal practices, including disposal of tank bottom sludges, existence of several above ground and below ground storage tanks, wood treating process areas, treated wood storage areas, acetylene sludge disposal (from offsite Navy acetylene production operations), and sand blasting grit and paint chips (potentially from adjacent Navy paint removal operations). Also VOCs have been detected in the groundwater, and the potential for a continuing source in the soil above the water table requires investigation. As a result, soil samples will be analyzed for Target Compound List (TCL) VOCs (EPA 8260B), PAHs and PCP (EPA 8270C), Target Analyte List (TAL) metals (EPA 6010B/7471A series) and dioxins/furans (EPA 8290).

Verification soil samples associated with the SCAPS investigation will be collected to evaluate the LIF probe readings and to verify the soil classification. As a results, the 20 SCAPS verification locations at four depths will be analyzed for PAHs and PCP (EPA 8270C), and TPH (EPA 8015 modified, diesel and gasoline range) to evaluate possible interference from petroleum compounds present at the site. In addition, 5 samples from the 20 SCAPS verification sample locations will be analyzed for soil classification (ASTM D2487) (particle size distribution, liquid limit, and plasticity index). Table 4-3 summarizes the analyses that will be performed on the soil samples. The Site Coordinator will work with the USACE SCAPS team to evaluate the

verification results in relation to the LIF readings at comparable locations and depths. The USACE SCAPS team will identify a correlation methodology based upon the team's previous experience and AWI site results.

4.3.1.4 QA/QC and Blank Samples and Frequency

QC samples are samples analyzed for the purpose of assessing the quality of the sampling procedures and laboratory analysis. QC samples include field samples that are collected or prepared by the field team and sent to the subcontract laboratory for analysis which identify and diagnose problems related to sampling, shipment, and laboratory analysis. Field QC samples to be collected for this field investigation and analyzed by the subcontract laboratory include rinsate blanks, source water blanks, trip blanks, duplicates, and MS/MSD samples. Also, temperature blanks will be included with each shipping container. Field QC samples will be collected at the frequencies provided below, and as summarized in Table 4-3.

Rinsate Blanks. Rinsate blank samples represent final rinse waters collected on decontaminated sampling equipment to evaluate the effectiveness of decontamination procedures. Rinsate blanks will be prepared by pouring ASTM Type II water over decontaminated sampling equipment and collecting the rinse water directly into sample containers. Rinsate blanks will be collected at the rate of one per day. Rinsate blanks will be analyzed for the same parameters to be analyzed that day, e.g., PAHs, PCP, TAL metals, VOCs, dioxins/furans, and TPH (only during SCAP verification sampling). It is estimated that rinsate blanks will be collected at the rate of five per week for PAHs and PCP, two per week for VOCs, and one per week for dioxins/furans and TPH.

Source Water Blanks. Source water blanks are samples of the water used for decontamination and rinsate water samples, used to evaluate whether contaminants are being introduced by the source water. Tap water samples (one per month) and ASTM Type II water samples (one per batch) will be collected by pouring directly into sample containers. It is estimated that four tap water samples and two ASTM Type II water samples will be collected.

Trip Blanks. Trip blanks are samples of analyte-free water (preserved to pH <2 with hydrochloric acid). They are sent by the laboratory to the field where they remain with the collected field samples until they are shipped back to the laboratory in coolers containing VOC soil samples and TPH (gasoline range) samples. Trip blanks will be submitted at the rate of one per cooler containing VOC soil samples (estimated to be two per week) and TPH gasoline range samples (estimated to be one per week).

Duplicates. Field duplicate samples are sent to the laboratory blind (i.e., not marked as duplicate samples) and are a check on the field sampler's technique and the homogeneity of the environmental media. These samples will be collected as a separate aliquot directly from the soil sampler for VOC and TPH analysis, and from the mixing bowl after homogenization for the remaining analyses. At the direction of USACE, duplicate soil samples will be analyzed by a separate subcontractor laboratory. These samples will be considered QA split samples. Duplicate samples will be analyzed at the rate of 5% of environmental samples. The provisions of EM 200-1-6 "Chemical Quality Assurance for HTRW Projects" dated 10 October 1997 will be observed including generating the Chemical Quality Assurance Report CQAR (Chapter 4).

Matrix Spike/Matrix Spike Duplicates. MS/MSD samples are submitted to the laboratory to evaluate site specific matrix interference (i.e., soil, sediment, water) throughout the sampling time period. To the extent possible, samples will be collected at the same interval and similar geologic formation to minimize heterogeneities in the samples. At the direction of USACE, only samples from this project will be used as MS/MSD samples. Additional sample volume will be collected and submitted for MS/MSD analyses at the rate of 5% of environmental samples.

4.3.2 PROCEDURES

4.3.2.1 Drilling Methods

Soil samples will be collected in non-Navy leased areas using a DPT rig and will follow CDM Federal SOP 3-1 (Appendix B). The DPT method obtains samples by hydraulically driving a 2-inch diameter, 48-inch long Geoprobe™ macro core sampler, fitted with a disposable acetate liner and piston, to the top of the desired sampling depth. The piston within the sampler is then released and the sampler is advanced through the selected sampling interval thereby allowing for the collection of an undisturbed sample. The sample is housed inside the acetate liner within the sampler which allows easy extraction from the sampler and minimizes contact between the sample and the interior of the sampler. The soil sampler is then retracted and the acetate liner, containing the soil sample, is removed from the sampler. Separate macro core soil samples will be collected in 2-ft intervals (i.e., the first macro core sampler will be collected from 0 to 2 ft and will be split up into 0-0.5 ft and 0.5 to 2 ft samples, and the second macro core sampler will be collected from 2 to 4 ft). Soil borings will be tremie grouted to the surface with a mixture of Portland Type II cement and bentonite powder or when appropriate, marked with PVC piping and grouted following the SCAPS investigation.

In Navy leased areas, hand augering methods will be used to collect soil samples so that ordnance avoidance can be performed. A discrete soil sample will be collected from the auger bucket at depths of 0 to 0.5 ft, 0.5 to 2 ft, and 2 to 4 ft. It is anticipated that some of the soil sample locations will require multiple attempts due to either auger refusal or detection of potential ordnance objects. As a result, several attempts may be necessary at offset locations. Should auger refusal cause sampling to not be possible, the location will be marked, and later collected using DPT or hollow stem auger drilling methods.

The SCAPS investigation will be performed by USACE using a cone penetrometer rig with a 40,000 pound hydraulic drive system mounted in a specially engineered truck. The penetrometer

drive system pushes a series of 1-meter long 1.5-inch I.D. threaded steel push pipes to a desired depth. The tip of the push rod is equipped with a specially designed probe containing electronic sensors that allow soil classification and soil fluorescence measurements to be taken as the probe tip is pushed directly into the subsurface environment. Sensors are connected to electronic signal processors through wiring bundled together into an umbilical cord. Two optic fibers are contained in the LIF sensor umbilical. Data are handled by an on-board computer system and electronic signal processing equipment. Sensor data are collected every 2 cm and displayed in the form of panel plots as they are acquired.

The boreholes generated as a result of pushing probe sensors from the SCAPS rig will be backfilled with a pumpable grout mixture of Portland Type II cement and bentonite powder to prevent vertical cross-contamination. In areas with detectable DNAPL, grout will be automatically pumped into the borehole as the probe is retracted. The probe is equipped with a 3/8-inch diameter grout tube which runs through the center of the push pipes. The end of the probe unit has an expendable grout tip, through which the grout will be pumped. In areas where DNAPL is not present, the SCAPS holes will be grouted after the probe has been retracted.

In areas with detectable DNAPL, SCAPS and DPT rigs will not penetrate the Yorktown confining unit.

4.3.2.1.1 Ordnance Avoidance For Soil Samples

An Unexploded Ordnance (UXO) team will be present to provide ordnance avoidance support services for all soil sampling and SCAPS support activities that involve initial intrusive disturbance of the fill material in the Navy Leased Area, which potentially contains buried UXO. The UXO team will provide the explosive ordnance recognition, location and safety function for CDM Federal, and their subcontractors. The UXO team leader will have the direct responsibility and is the technical lead for all UXO operations on the site, and the final authority for CDM Federal and their subcontractors regarding all matters concerning UXO.

The UXO team will conduct a visual reconnaissance (i.e., no instruments) of the sampling area. The reconnaissance will include locating a clear path for the sample crews, vehicles, and equipment to approach the site. The approach path at a minimum will be twice the width of the widest vehicle. The UXO team will clearly mark all boundaries of the cleared approach path to prevent personnel from straying into uncleared areas. All vehicular and pedestrian traffic will be contained within the cleared paths. Note that visual reconnaissance will not be used for intrusive investigation.

The UXO team will use a magnetometer probe to locate magnetic anomaly free areas for each sampling location. The magnetometer probe will be capable of detecting anomalies from sources within a zone that is 1 ft in radius and 2 ft below the probe. If a preselected area indicates a magnetic anomaly, then a new, nearby, sampling site will be chosen.

Soil samples will be collected in 2-ft intervals using a hand auger. A magnetometer probe will be lowered into the borehole after each 2-ft interval is removed to investigate the underlying 2 ft for magnetic anomalies. This procedure will continue until natural soil is encountered or the bottom depth of the sample is collected. Should refusal be encountered during hand augering, then a nearby location will be selected for sampling. If several attempts have been made with the hand auger, and refusal is still encountered, then the location will be sampled using a DPT rig.

When DPT sampling is required, the DPT crew will sample the fill soil from a depth interval of 0 to 2 ft, then move the DPT rig approximately 20 ft from the sample location as the UXO team investigates the next 2 ft underlying the bottom of the borehole. The UXO team will do this by lowering the magnetometer probe down the borehole to the bottom. If the boring location remains free of magnetic anomalies, the DPT rig will return to the boring location and the process continued as necessary.

If at any point a magnetic anomaly is detected, then the boring location will be moved to a nearby location free of magnetic anomalies at the surface and the procedure will be repeated. If several

alternate sampling locations have been attempted without success, then excavation to identify the source of the anomaly may be required to clear the sampling location, at the discretion of CDM Federal and USACE.

If any UXO is found and positively identified by the UXO team, CDM Federal will notify the Norfolk Naval Shipyard Explosive Ordnance Disposal group; USACE Norfolk District, USACE Baltimore District, and USACE Huntsville Center for Expertise for UXO.

Once natural soil is encountered, ordnance avoidance procedures are not required to continue for any deeper intrusive activities (i.e., SCAPS sampling and SCAPS verification sampling) and the UXO team's presence will not be required.

4.3.2.2 Boring Logs

The twenty boreholes completed during the SCAPS verification sampling will be logged by the onsite geologist and geologic observations will be recorded on boring logs. A sample HTW Drill Log Form is included in Appendix C and instructions for drilling log completion are included in CDM Federal SOP 3-5 (Appendix B). In addition to completing the lithologic log for each borehole, the onsite geologist will maintain a field logbook to record all relevant information related to borehole drilling.

4.3.2.3 Field Measurement Procedures and Criteria

During soil sampling activities, an Organic Vapor Monitor (OVM) will be used by the sampling team to verify that elevated organic vapors are not present. Also, soil samples on Navy-leased property will be scanned with radiation meters as a precaution to ensure that soil samples do not contain radioactivity (based on reported past soil filling activities on properties adjacent to AWI, there is the potential for uncovering low levels of radium-226 contaminated soil). Two types of portable radiation survey instruments will be used during the investigation. An alpha

scintillation probe will be used with a scaler/ratemeter to detect the presence of alpha contamination. A pancake G-M probe will be used with a scaler/ratemeter to detect the presence of beta/gamma emitting radionuclides. Scaler/ratemeters are useful for scanning with the audible output or for fixed counting at preset count times. Although the instruments are useful for identifying relatively low levels of radioactivity, they do not identify the specific radionuclides present. Operation and calibration of OVMs and radiation meters will follow the manufacturer's standard procedures.

4.3.2.4 Samples for Physical Analyses

A total of 5 subsurface soil samples will be collected for soil characteristics (soil classification, particle size distribution, liquid limit and plasticity index) as shown in Table 4-3. These samples will be chosen based on observations during the time of sampling and will represent stratigraphic changes encountered at the site.

4.3.2.5 Samples for Chemical Analyses

The general procedures for collecting soil samples are presented in Section 4.3.2.1. This section presents additional details on the methods for preserving and packing the samples once they have been retrieved.

- Immediately collect the grab sample(s) for VOC and TPH analysis (if applicable) from the soil sampler and fill the sample containers (pack the containers completely to eliminate headspace).
- For the remaining analyses, place the soil from the soil sampler into a mixing bowl, homogenize, and place into sample bottles.
- Immediately place sample containers into a cooler with ice.

- Package and ship samples to the laboratory according to the procedures provided in Section 6.0.

4.3.2.6 Sample Containers, Preservation, and Holding Times

Requirements for soil sample containers, preservation, and holding times are specified in Table 4-4. Requirements for water (e.g., rinsate blanks) sample containers, preservation, and holding times are specified in Table 4-5.

4.3.2.7 Field Quality Control Sampling Procedures

QC samples to be collected in the field will include rinsate blanks, source water blanks, trip blanks, duplicates, and MS/MSDs. The sampling procedures for the collection of QC samples are described in Section 4.3.1.4.

4.3.2.8 Decontamination Procedures

Decontamination procedures will follow CDM Federal SOP 4-5 (Appendix B). CDM Federal will inspect the DPT rig upon arrival to ensure that no residual contamination, hydraulic leaks, etc., are present. The DPT rig will be decontaminated at the start and end of the project with a high pressure, hot water pressure cleaner. All DPT down hole equipment (e.g., drive rods, sampler pistons), excluding soil samplers, will be decontaminated between samples with a high pressure, hot water cleaner.

All other reusable sampling equipment (e.g., stainless steel soil samplers, hand augers, mixing bowls, spatulas) will be decontaminated between samples using the following procedure:

- Phosphate-free detergent wash
- Rinse with clean, potable water

- Rinse with ultra-pure 10% nitric acid (when sampling for metals analysis)
- Rinse with ASTM Type II water
- Isopropanol rinse
- Rinse with ASTM Type II water
- Air dry and wrap in aluminum foil for transport

4.4 SEDIMENT

4.4.1 RATIONALE

Sediment samples will be collected from 25 locations in the study area. As shown in Figure 4-7, sediment samples will be collected from the Western Ditch, Storm Water Ditch, and Southeastern Ditch. Sediment samples will be collected by hand augering techniques given that the drainage ditches are normally dry except for during rain events.

4.4.1.1 Sediment Sample Locations

The purpose of sediment sampling is to define the lateral and vertical extent of sediment contamination above the water table that exceeds ROD cleanup levels (or risk-based screening levels). As a result, a systematic linear grid sampling pattern was selected to collect data along the entire length of the drainage ditches. Sediment samples will be collected from the middle of the drainage ditches, which is the lowest point where contaminants are expected to be deposited.

The grid spacing is dependent on the analyses being performed, as shown in Figure 4-7, and summarized below (VOCs will not be analyzed, because they were not detected in the RI sediment samples).

- **Define PAHs and PCP Contamination:** Collect sediment samples on 100-ft linear grid. Sample at one depth (0-0.5 ft).

- **Define Metals Contamination:** Collect sediment samples on 100-ft linear grid. Sample at depth (0-0.5 ft).
- **Define Dioxins/Furans Contamination:** Collect sediment samples on 200-ft linear grid. Sample at one depth (0-0.5 ft).

4.4.1.2 Discrete/Composite Sediment Sampling Requirement

Sufficient sediment sample volume from a single location will be collected using a stainless steel hand auger and will be placed into a stainless steel mixing bowl. The sample will then be homogenized, from which the aliquots will be collected. This will provide a homogeneous sample for these analyses.

4.4.1.3 Sample Collection and Laboratory Analysis

Sediment sampling procedures will be performed using a stainless steel hand auger, selected to allow for the collection of sediment samples in a simple and rapid manner, given that the drainage ditches are normally dry except during rain events.

CDM Federal will utilize an offsite laboratory for sediment sample analysis. Analytical parameters were selected based on existing knowledge of the types of contaminants present in the study area. The primary contamination source is due to run off from the treatment area and the wood storage area (some of which stored CCA treated wood). As a result, all 25 sediment samples will be analyzed for PAHs (EPA 8270C) and PCP (EPA 8151A), and TAL metals (EPA 6010B/7471A series). In addition, 13 of the 25 sediment samples will also be analyzed for dioxins/furans (EPA 8290). Table 4-6 identifies the analyses that will be performed on the sediment samples.

4.4.1.4 QA/QC and Blank Samples and Frequency

QC samples are samples analyzed for the purpose of assessing the quality of the sampling procedures and laboratory analysis. QC samples include field samples that are collected or prepared by the field team and sent to the subcontract laboratory for analysis which identify and diagnose problems related to sampling, shipment, and laboratory analysis. Field QC samples associated with sediment sampling include rinsate blanks, duplicates, and MS/MSDs. Source water blanks associated with the entire field investigation are described in Section 4.3. Field QC samples will be collected at the frequencies provided below, and as summarized in Table 4-6.

Rinsate Blanks. Rinsate blank samples represent final rinse waters collected on decontaminated sampling equipment to evaluate the effectiveness of decontamination procedures. Rinsate blanks will be prepared by pouring ASTM Type II water over decontaminated sampling equipment and collecting the rinse water directly into sample containers. Rinsate blanks will be collected at the rate of one per day for the same parameters collected that day, e.g., PAHs, PCP, TAL metals, and dioxins/furans. It is estimated that rinsate blanks will be collected at the rate of five per week for PAHs, PCP, and metals, and one per week for dioxins/furans.

Duplicates. Field duplicate samples are sent to the laboratory blind (i.e., not marked as a duplicate sample) and are a check on the field sampler's technique and the homogeneity of the environmental medium. At the direction of USACE, duplicate samples will be analyzed by a separate subcontractor laboratory. These samples will be considered QA split samples. Duplicate sediment samples will be collected at the rate of 5% of environmental samples. The provisions of EM 200-1-6 "Chemical Quality Assurance for HTRW Projects" dated 10 October 1997 will be observed including generating the Chemical Quality Assurance Report CQAR (Chapter 4).

Matrix Spike/Matrix Spike Duplicates. MS/MSD samples are submitted to the laboratory to evaluate site specific matrix interference (i.e., soil, sediment, water) throughout the sampling

time period. To the extent possible, samples will be collected at the same interval and similar geologic formation to minimize heterogeneities in the samples. At the direction of USACE, only samples from this project will be used for MS/MSD samples. Additional sample volume will be collected and submitted for MS/MSD analyses at the rate of 5% of environmental samples.

4.4.2 PROCEDURES

4.4.2.1 Sampling Methods for Sediment

Sediment samples will be collected using a hand auger and will follow CDM Federal SOP 1-1 (Appendix B). The samples will be collected from the middle of the drainage ditches at the lowest point where contaminants are expected to be deposited. Any liquid phase will be slowly decanted off from the sample. The sediment sampling will be performed by collecting sufficient volume to fill all of the required sample bottles and will be homogenized in a stainless steel mixing bowl.

4.4.2.1.1 Ordnance Avoidance For Sediment Sampling

Sediment sampling performed in the Navy leased area will follow the ordnance avoidance procedures described in Section 4.3.2.1.1.

4.4.2.2 Samples for Chemical Analyses

The general procedures for collecting sediment samples are presented above. This section presents additional details on the methods for preserving and packing the samples once they have been retrieved.

- Place the sediment sample into a mixing bowl, homogenize, and place into sample bottles.
- Immediately place sample containers into a cooler with ice.
- Package and ship samples to the laboratory according to the procedures provided in Section 6.0 of the FSP.

4.4.2.3 Sample Containers, Preservation, and Holding Times

Requirements for sediment sample containers, preservation, and holding times are specified in Table 4-7. Requirements for water (e.g., rinsate blanks) sample containers, preservation, and holding times are specified in Table 4-5.

4.4.2.4 Field Quality Control Sampling Procedures

QC samples to be collected in the field will include rinsate blanks, duplicates, and MS/MSDs. Source water blanks associated with the entire field investigation are described in Section 4.3. The sampling procedures for the collection of QC samples is described in Section 4.4.1.4.

4.4.2.5 Decontamination Procedures

Decontamination procedures will follow CDM Federal SOP 4-5 (Appendix B). All sampling equipment (e.g., stainless steel hand augers, mixing bowls, spatulas) will be decontaminated prior to sampling using the following procedure:

- Phosphate-free detergent wash
- Rinse with clean, potable water
- Rinse with ultra-pure 10% nitric acid (when sampling for metals analysis)

- Rinse with ASTM Type II water
- Isopropanol rinse
- Rinse with ASTM Type II water
- Air dry and wrap in aluminum foil.

TABLE 4-1
FIELD EQUIPMENT AND SUPPLIES

Equipment	Field Supplies (continued)
Water Level Indicator	Pens & Sharpie Markers
Oil/Water Interface Probe	ASTM Type II Water
Organic Vapor Monitor	Isopropanol
Radiation Meters (alpha scintillation and pancake G-M and standards)	Liquinox
Explosimeter/Oxygen Meters	Wash Tubs & Short Handle Brushes
Field Supplies	Spray Bottles and Garden Sprayers
<i>Miscellaneous Supplies</i>	<i>Personal Protective Supplies</i>
Explosimeter Calibration Gas	APR Cartridges (MSA Ultratwin)
OVN Calibration Gas (Isobutylene 100 ppm)	Eye Wash Station
Munsell Soil Color Chart	First-Aid Kit
Hand Lens	Gloves - Latex and Neoprene
Paint Pens for Drums	Rainsuits
Drums	Tyvek & Overboots
Fire Extinguisher	<i>Sampling Supplies</i>
Water Cooler	Sample Bottles/Labels
Compass	Field Logbooks, Waterproof
Barrier Tape	Plastic Sample Bags
Spray Paint	Vermiculite
Exclusion Flagging	Chain-of-Custody Seals and Forms
Camera	Coolers
Pin Flags	Ice
Wooden Stakes	Strapping, Acetate and Duct Tape
Two-way Radios	HCL Preservative
Measuring Tape - 300' Fiberglass	HNO ₃ Preservative
Hand Tools	Aluminum Foil
Funnels	Shipping Airbills
Garbage Bags	Stainless Steel Hand Augers
Paper Towels	Stainless Steel Bowls, Spoons, and Spatulas

TABLE 4-2
SUMMARY OF ENVIRONMENTAL SAMPLING ACTIVITIES

ACTIVITY	NUMBER OF LOCATIONS	NUMBER OF DEPTHS	TOTALS ¹
SOIL SAMPLING			
VOCs (west side)	34	1	34
VOCs (east side)	32	1	32
PAHs/PCP (west side)	167	2	334
PAHs/PCP (east side)	230	2	460
TAL metals (west side)	132	2	264
TAL metals (east side)	168	2	336
Dioxins/furans (west side)	40	2	80
Dioxins/furans (east side)	32	2	64
SCAPS SUPPORT/SOIL SAMPLING			
Probe locations	295	--	295
PAHs/PCP & TPH	20	4	80
Soil Characteristics	5	1	5
Visual logging locations	20	continuous	continuous
SEDIMENT SAMPLING			
PAHs/PCP (west side)	12	1	12
PAHs/PCP (east side)	13	1	13
TAL metals (west side)	12	1	12
TAL metals (east side)	13	1	13
Dioxins/furans (west side)	6	1	6
Dioxins/furans (east side)	7	1	7

Notes:

¹Sample numbers exclude QA/QC sample requirements.

TABLE 4-3
SUMMARY OF ANALYTICAL PROCEDURES FOR SOIL SAMPLES

Analysis Type	TCL VOCs (EPA ¹ 8260B)	PAHs & PCP (EPA 8270C)	TAL Metals (EPA 6010B/7471 A Series)	Dioxin/Furans (EPA 8290)	TPH ² (EPA 8015 Mod)	Soil Characteristics (ASTM ³ D2487)
Soil (West Side)	34	334	264	80	--	--
Soil (East Side)	32	460	336	64	--	--
SCAPS Verification	--	80	--	--	80	5
Rinsate Blanks	15	80	80	15	8	--
Source Water Blanks	6	6	6	6	6	--
Trip Blanks	30	--	--	--	8	--
Duplicates	4	44	32	9	4	1
MS/MSD (Soil)	10	88	64	9	4	--
MS/MSD (Water Blanks)	6	12	4	1	1	--
MS/MSD (Duplicates)	7	5	3	1	1	--
Totals	144	1109	789	185	112	6

Notes:

¹U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

²TPH - Total Petroleum Hydrocarbons (diesel and gasoline range).

³ASTM - American Society for Testing and Materials, Current Edition (soil classification, particle size distribution, liquid limit and plasticity index).

Rinsate Blanks - Analyzed for same parameters to be analyzed that day (estimate 5 per week for PAHs and PCP, 2 per week for VOCs, and 1 per week for Dioxins/Furans and TPH).

Source Water Blanks - Tap water sample collected 1 per month, and ASTM Type II water sample collected 1 per batch (estimate 2 batches).

Trip Blanks - 1 per cooler containing VOC soil samples (estimate 2 per week) and TPH (gasoline range) samples (estimate 1 per week during SCAPS verification).

Duplicates - Analyzed at 5% of environmental samples and will be submitted to a separate laboratory.

MS/MSD - Analyzed at 5% of environmental samples from each matrix and distributed throughout the sampling time period.

TABLE 4-4
SOIL SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Method	Sample Container ¹	Preservative	Holding Time ²
TCL VOCs	EPA ³ 8260B Soil Prep. EPA 5030B/5035	Three EnCore™ Soil Samplers and one 4-oz. glass jar ⁴	Cool to 4°C	2 days to preservation 14 days to analysis
PAHs and PCP	EPA 8270C/8151A ⁵ Soil Prep. EPA 3550B	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days to extraction 40 days to analysis
TAL Metals	EPA 6010B/7471A series Soil Prep. EPA 3550B	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	180 days (28 days for mercury)
Dioxins/Furans	EPA 8290 Soil Prep. In Analytical Method	4-oz. widemouth amber glass jar with Teflon-lined closure	Cool to 4°C	30 days to extraction 40 days to analysis
TPH (Diesel Range)	EPA 8015 (modified) Soil Prep. In Analytical Method	4-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days to extraction 40 days to analysis
TPH (Gasoline Range)	EPA 8015 (modified) Soil Prep. In Analytical Method	4-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days
Soil Classification	ASTM ⁶ D2487 Soil Prep. In Analytical Method	Two 16-oz. widemouth glass jars	None	None

Notes:

¹Sample containers will be packed full to minimize headspace. Double sample volume may be required for soil MS/MSD analyses.

²Holding time begins at the time of sample collection.

³U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

⁴The 4-oz. glass jar is a dry weight sample (collected as a typical VOA sample) and is sent to the laboratory for dry weight analysis.

⁵EPA Method 8270C will be used to determine pentachlorophenol concentrations in soil and Method 8151A will be used to determine pentachlorophenol concentration in sediment.

⁶American Society for Testing and Materials, Annual Book of ASTM Standards. Current Edition.

TABLE 4-5
WATER SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Method	Sample Container	Preservative	Holding Time ¹
TCL VOCs	EPA ² 8260B Water Prep. EPA 5030B	Three 40-mL glass vials with Teflon-lined septum	HCL to pH <2 Cool to 4°C	14 days
PAHs and PCP	EPA 8270C Water Prep. EPA 3510C/3520C	Two 1-L amber glass jars with Teflon-lined closure	Cool to 4°C	7 days to extraction 40 days to analysis
TAL Metals	EPA 6010A/7470A series Water Prep. In Analytical Method	1-L polyethylene with polyethylene closure	HNO ₃ to pH<2 Cool to 4°C	180 days (28 days for mercury)
Dioxins/Furans	EPA 8290 Water Prep. In Analytical Method	Two 1-L amber glass jar with Teflon-lined closure	Cool to 4°C	30 days to extraction 40 days to analysis
TPH (Diesel Range)	EPA 8015 (modified) Water Prep. In Analytical Method	1-L amber glass jar with Teflon-lined closure	Cool to 4°C	7 days to extraction 40 days to analysis
TPH (Gasoline Range)	EPA 8015 (modified) Water Prep. In Analytical Method	Two 40-ml glass vials with Teflon-lined septum	HCL to pH <2 Cool to 4°C	14 days

Notes:

¹Holding time begins at the time of sample collection.

²U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

TABLE 4-6
SUMMARY OF ANALYTICAL PROCEDURES FOR SEDIMENT SAMPLES

Analysis Type	PAHs & PCP (EPA¹ 8270C/8151A)	TAL Metals (EPA 6010B/7471A Series)	Dioxin/Furans (EPA 8290)
Sediment (West Side)	12	12	6
Sediment (East Side)	13	13	7
Rinsate Blanks	1	1	1
Duplicates	2	2	1
MS/MSD (sediment)	2	2	2
MS/MSD (duplicates)	1	1	1
Totals	31	31	18

Notes:

¹U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods (SW-846), Current Edition.

Rinsate Blanks - Analyzed for same parameters to be analyzed that day (estimate 5 per week for PAHs and PCP, and 1 per week for Dioxins/Furans).

Duplicates - Analyzed at 5% of environmental samples and will be submitted to separate laboratory.

MS/MSD - Analyzed at 5% of environmental samples from each matrix and distributed throughout the sampling time period.

TABLE 4-7
SEDIMENT SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Method	Sample Container ¹	Preservative	Holding Time ²
PAHs and PCP	EPA ³ 8270C/8151A ⁴ Soil Prep. 3550B	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days to extraction 40 days to analysis
TAL Metals	EPA 6010B/7471A series Soil Prep. In Analytical Method	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	180 days (28 days for mercury)
Dioxins/Furans	EPA 8290 Soil Prep. In Analytical Method	4-oz. widemouth amber glass jar with Teflon-lined closure	Cool to 4°C	30 days to extraction 40 days to analysis

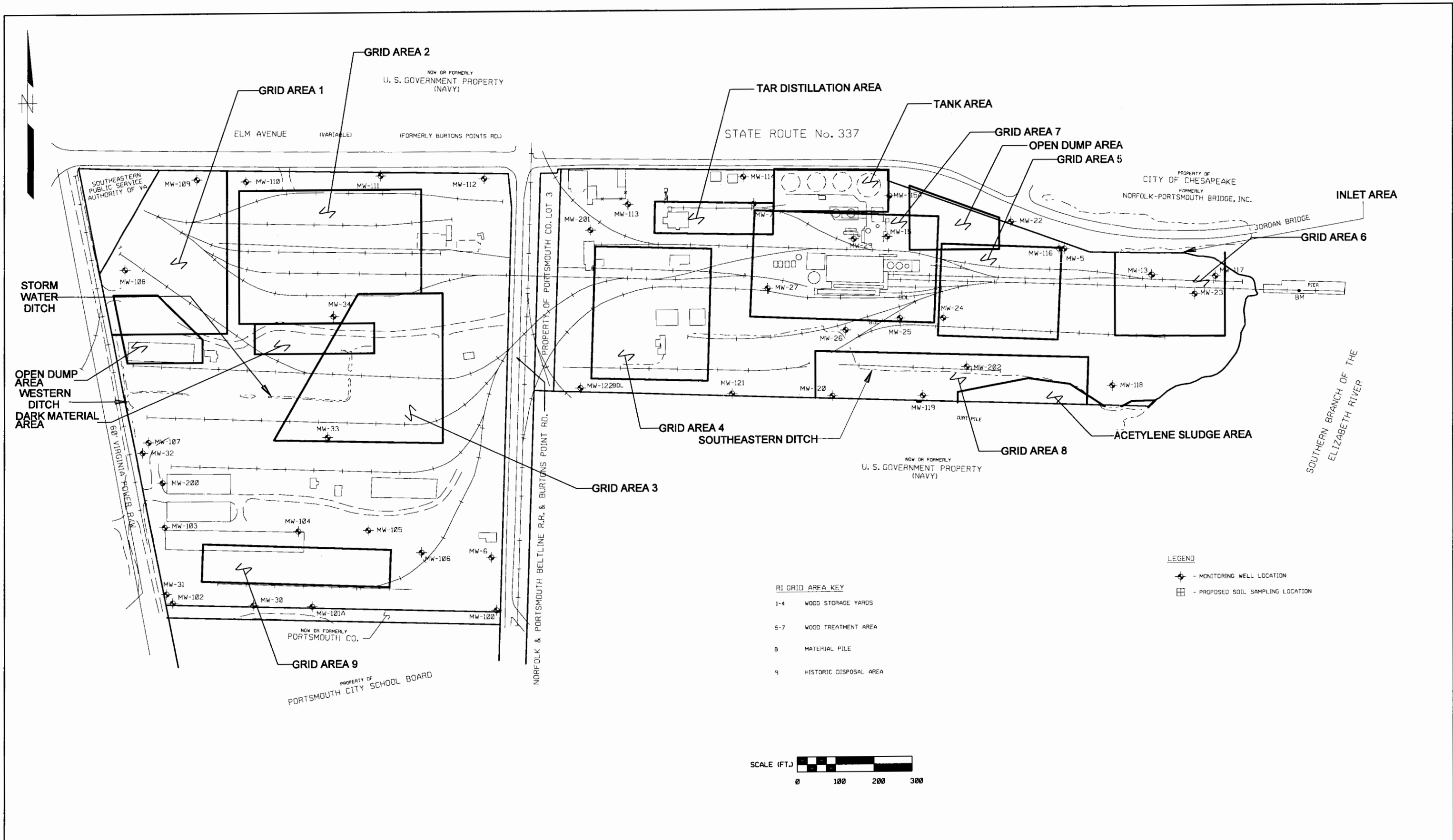
Notes:

¹Sample containers will be packed full to minimize headspace. Double sample volume may be required for sediment MS/MSD analyses.

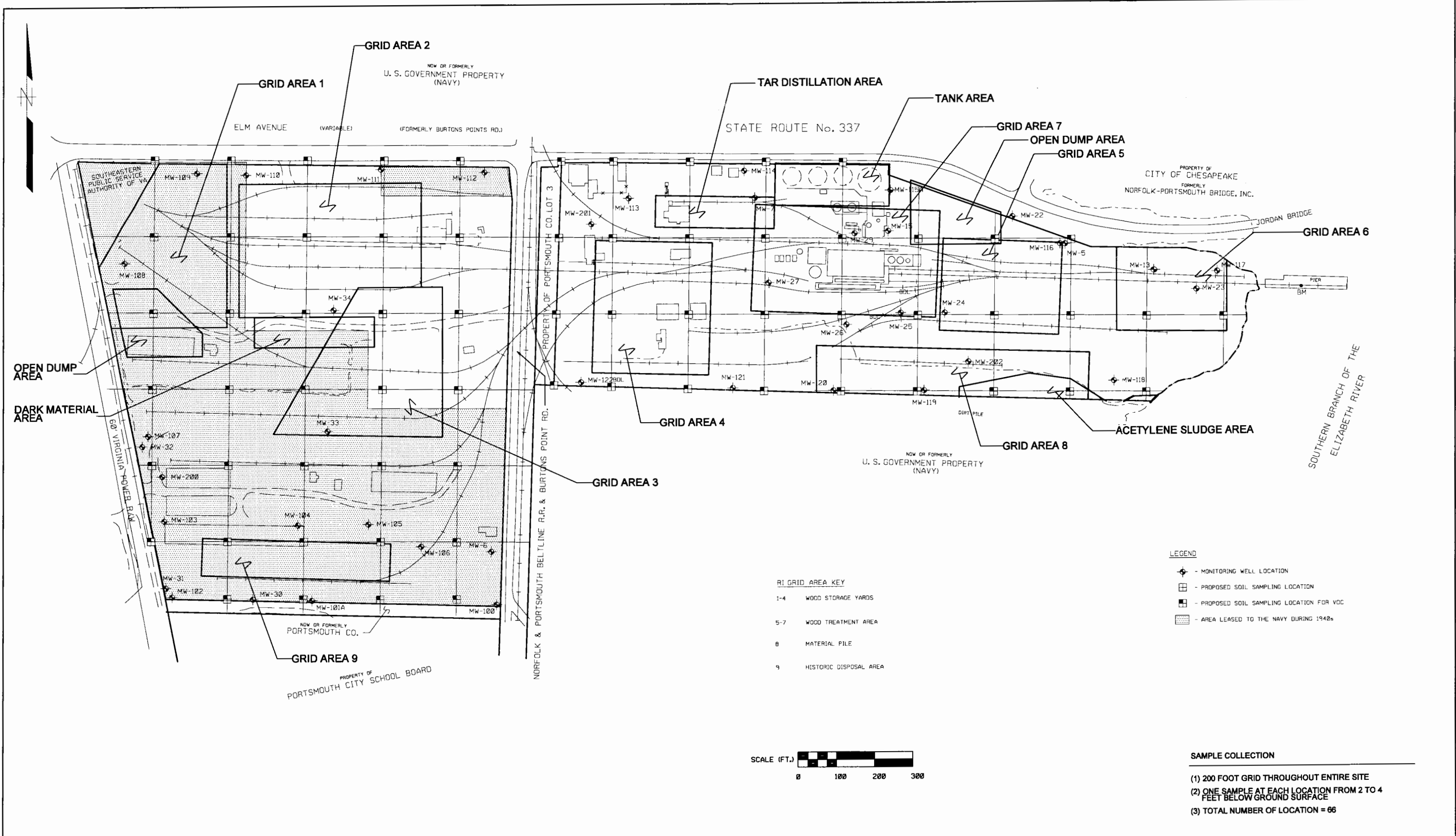
²Holding time begins at the time of sample collection.

³U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

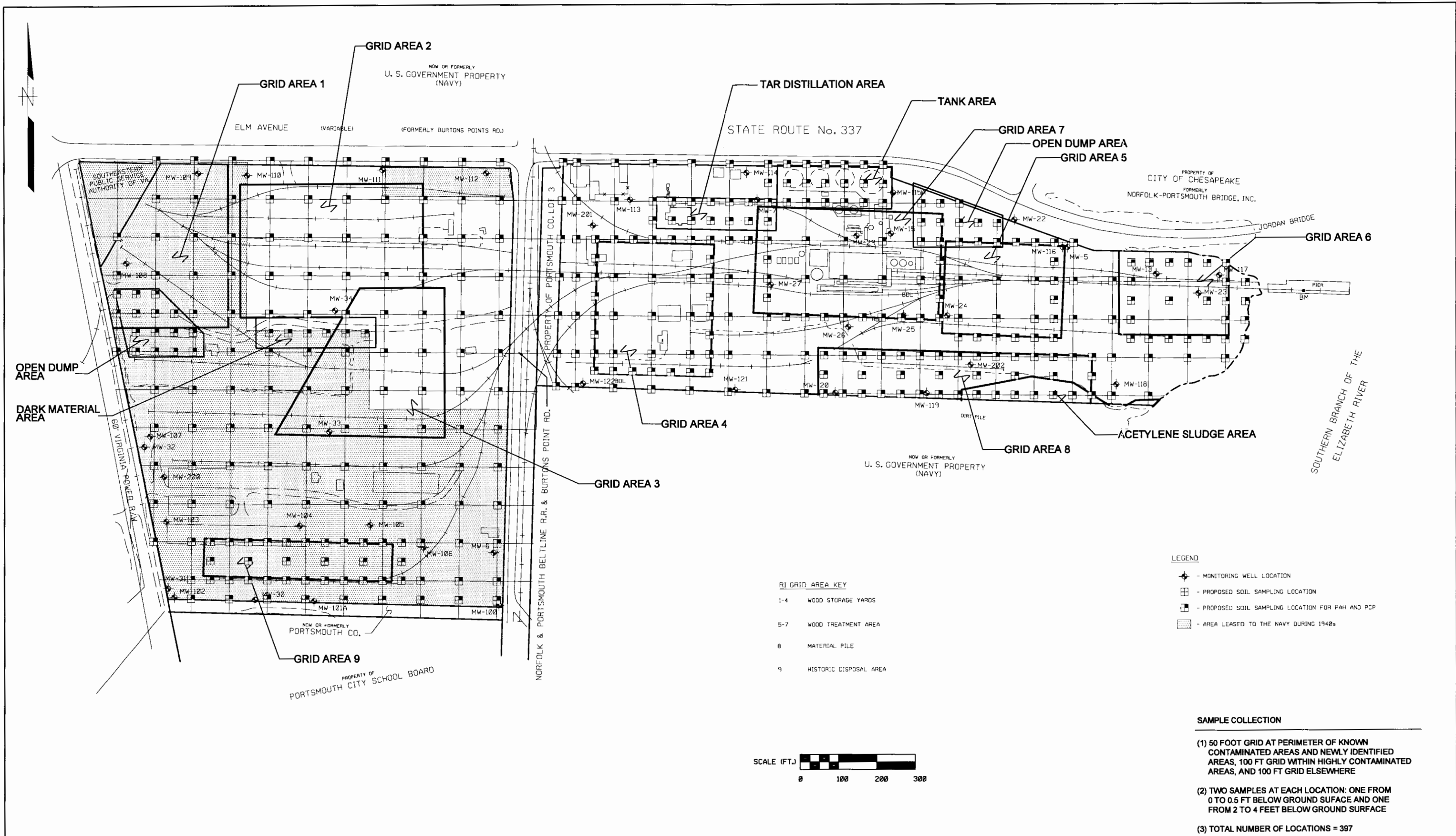
⁴EPA Method 8151A will be used to determine pentachlorophenol concentration in sediment.



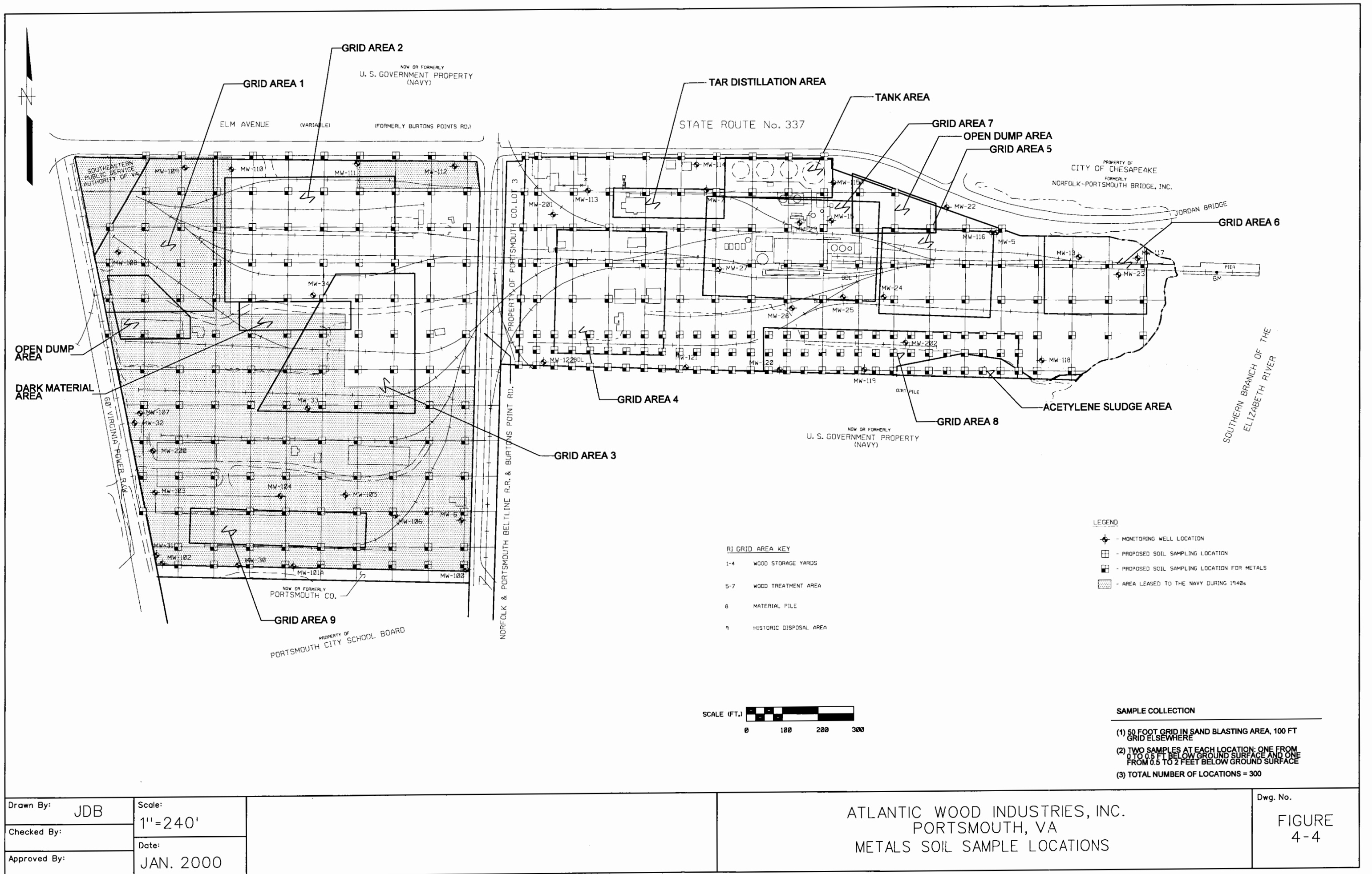
Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA SITE MAP	Dwg. No.
Checked By:	Date:		FIGURE 4-1
Approved By:	JAN. 2000		

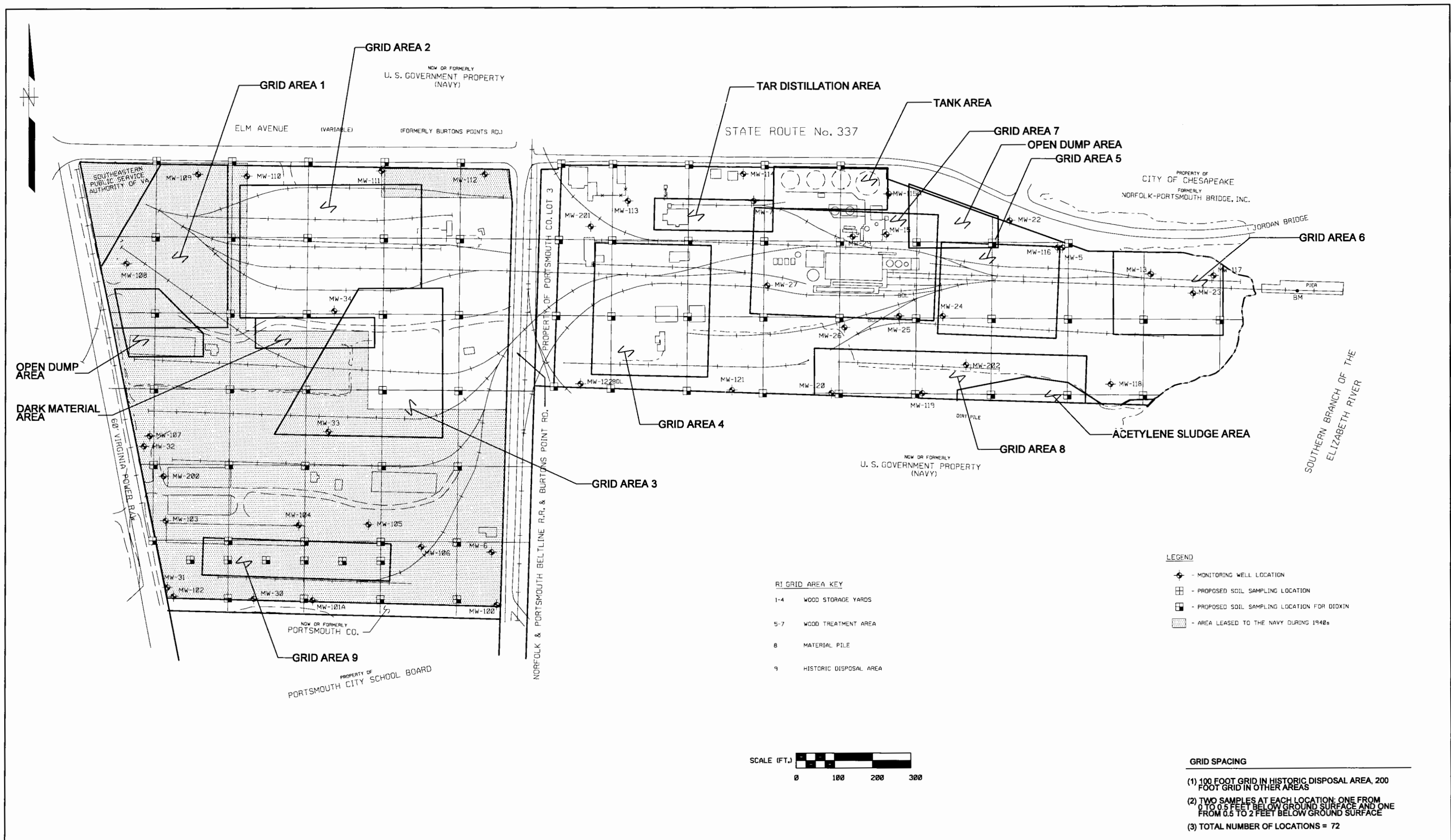


Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA VOC SOIL SAMPLE LOCATIONS	Dwg. No. FIGURE 4-2
Checked By:	Date:		
Approved By:	JAN. 2000		

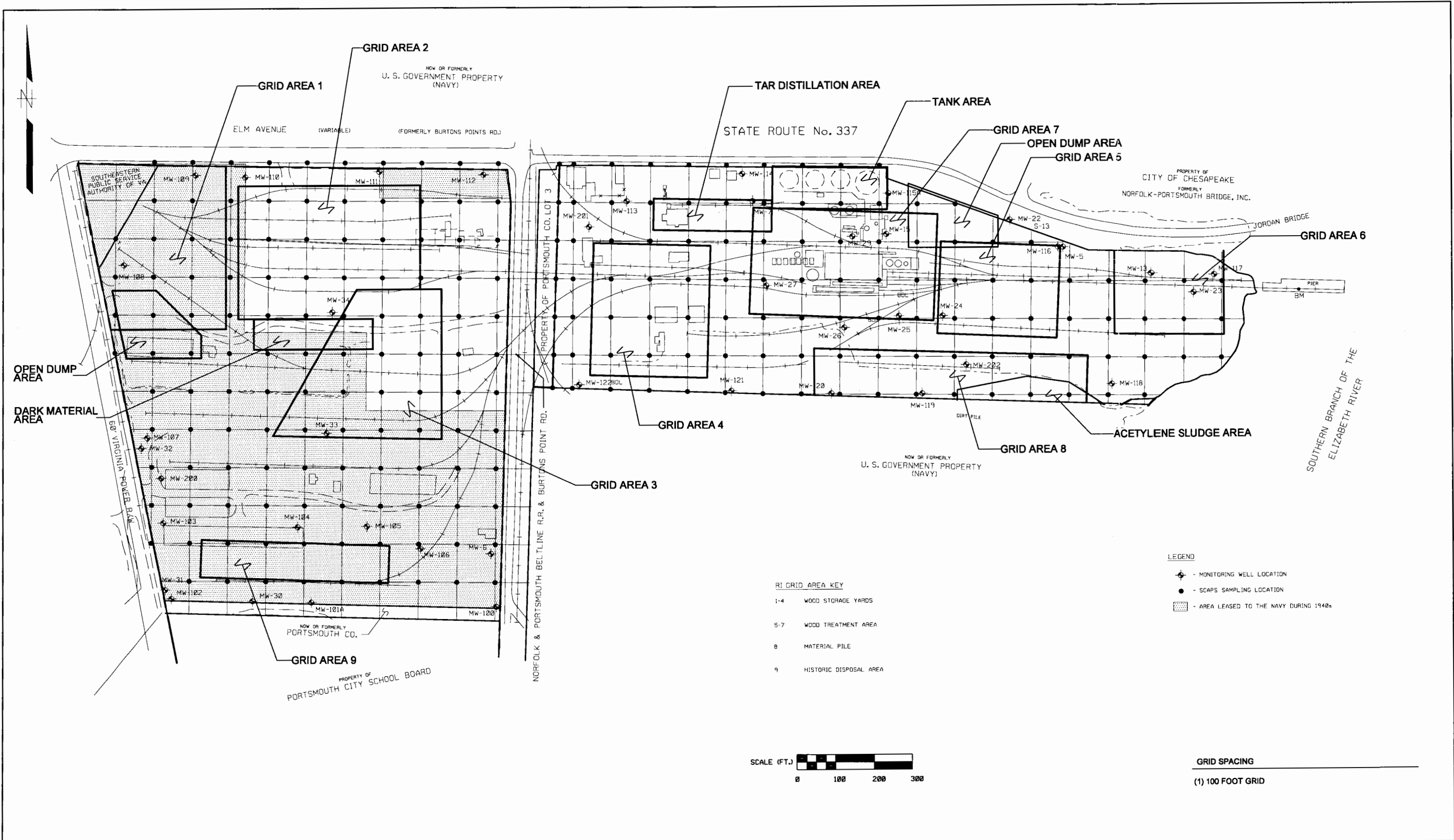


Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA PAH AND PCP SOIL SAMPLE LOCATIONS	Dwg. No. FIGURE 4-3
Checked By:	Date: JAN. 2000		
Approved By:			

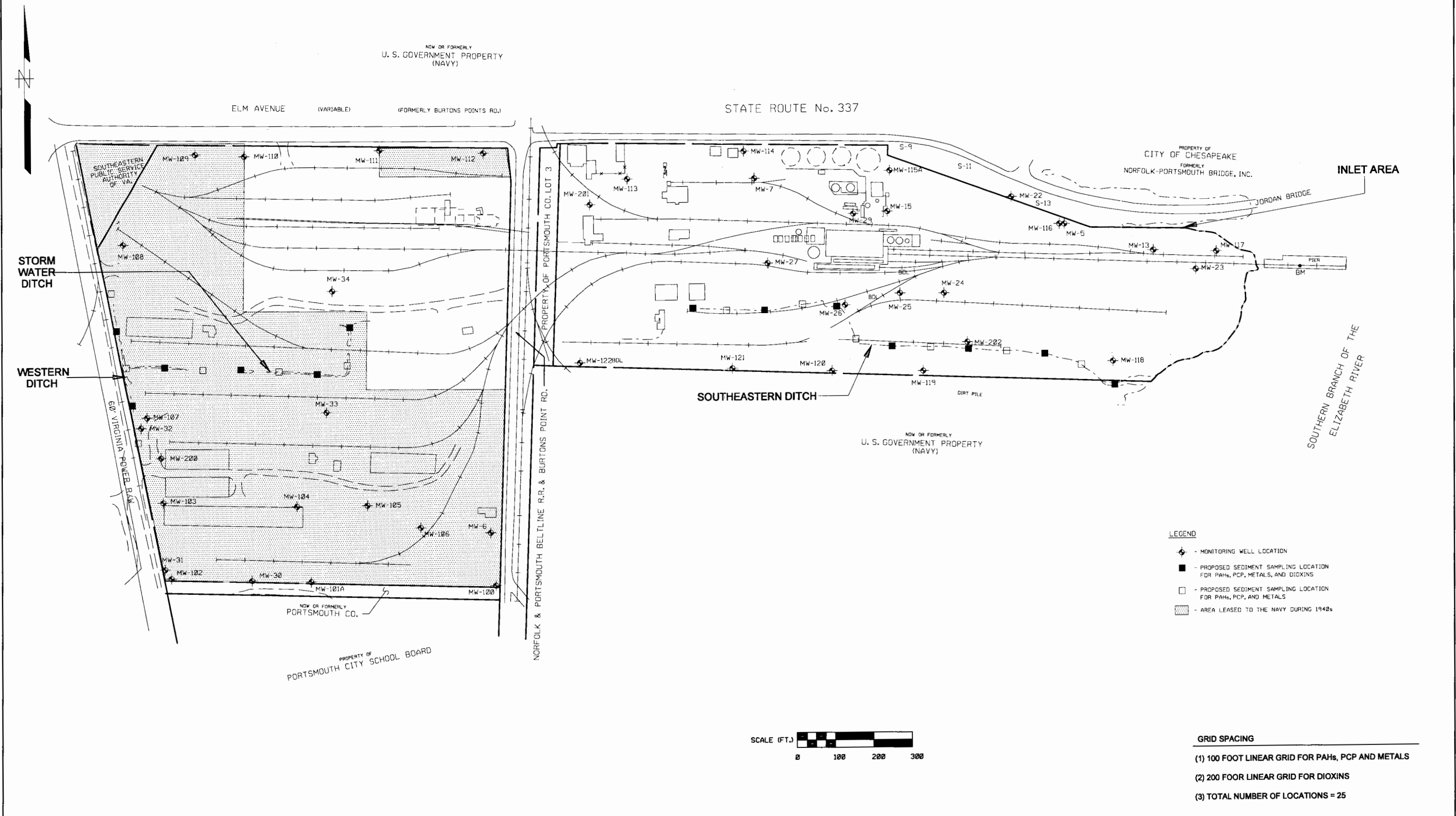




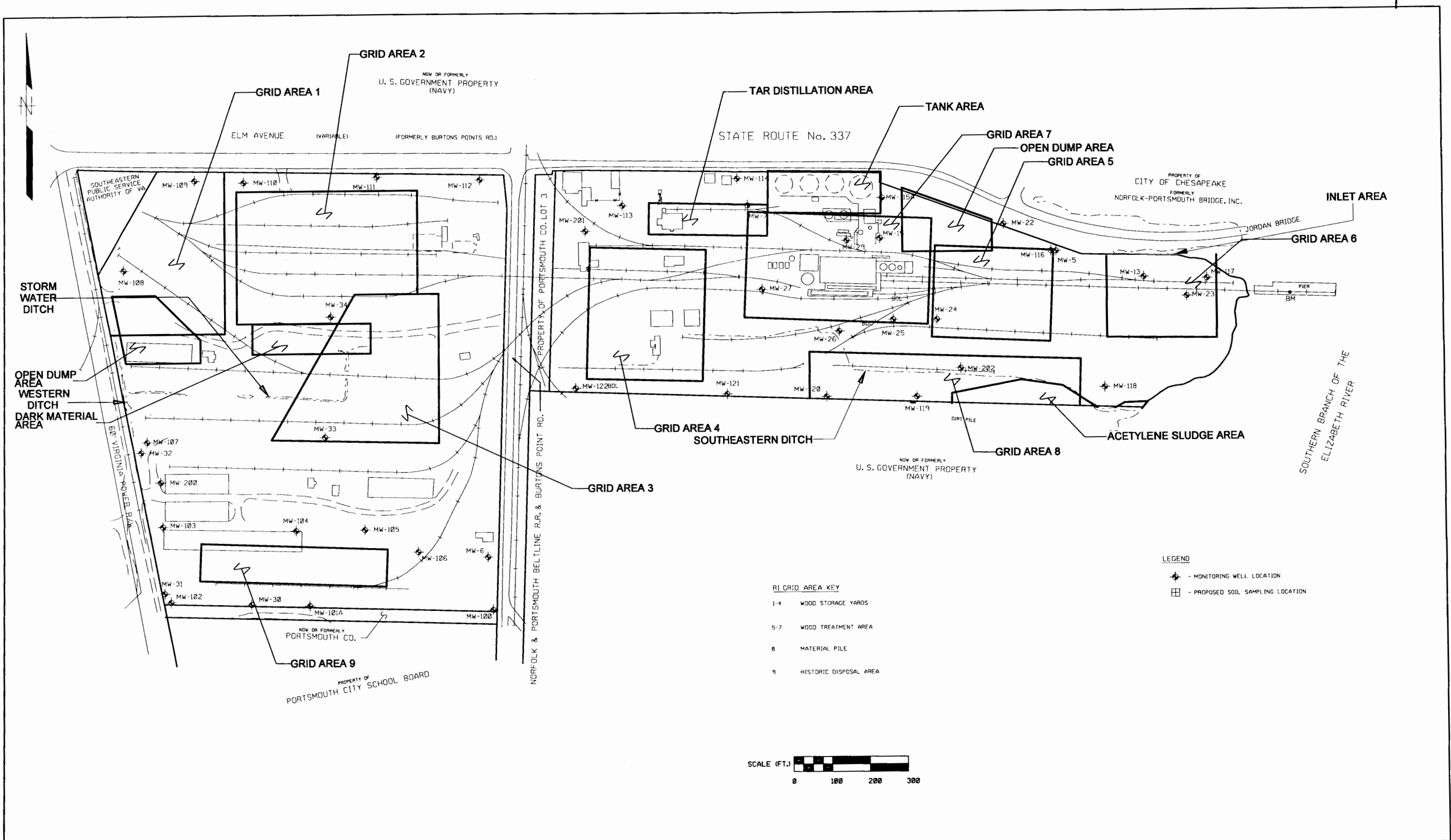
Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA DIOXINS/FURANS SOIL SAMPLE LOCATIONS	Dwg. No. FIGURE 4-5
Checked By:	Date:		
Approved By:	JAN. 2000		



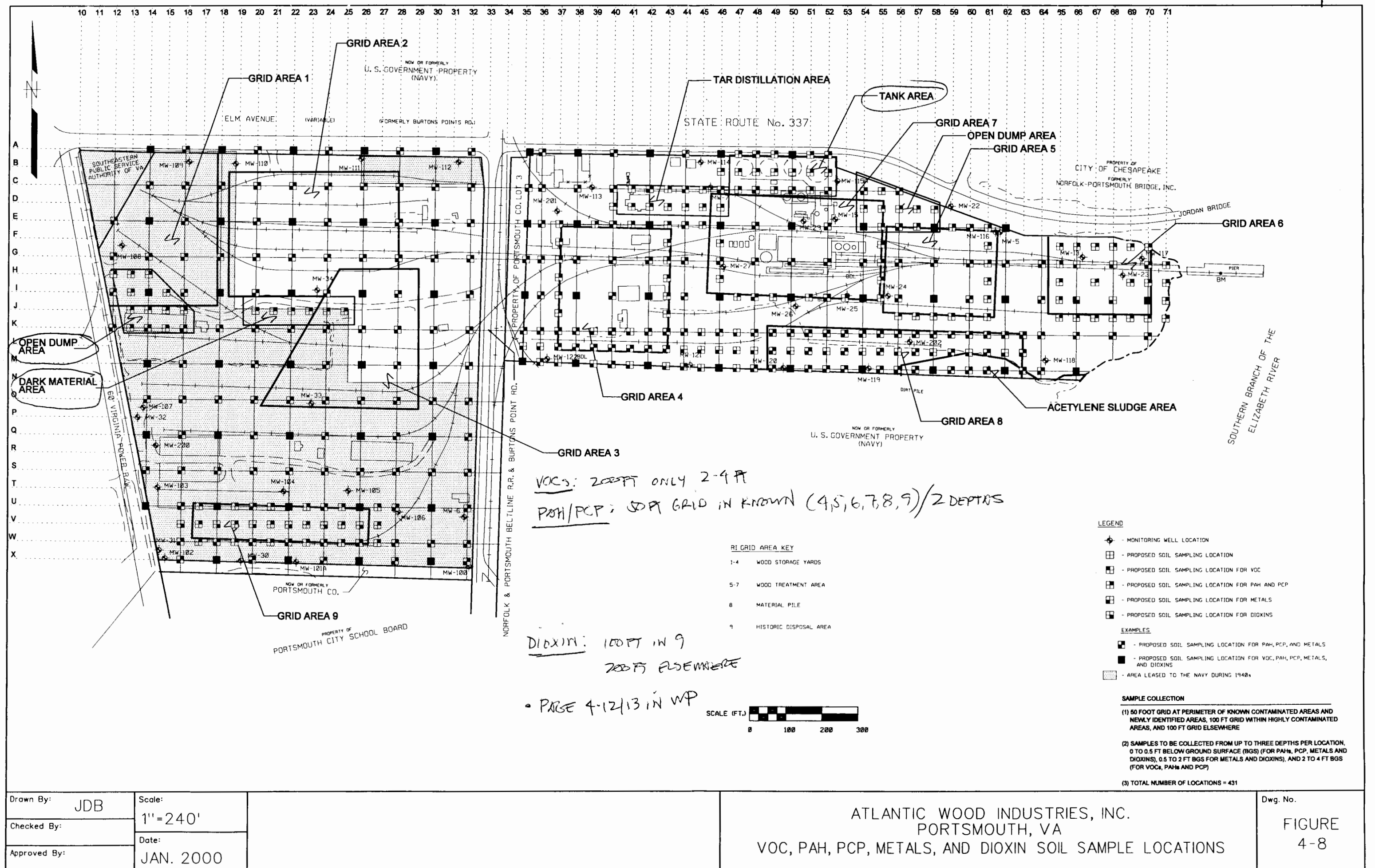
Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA SCAPS SAMPLE LOCATIONS	Dwg. No. FIGURE 4-6
Checked By:	Date: JAN. 2000		
Approved By:			

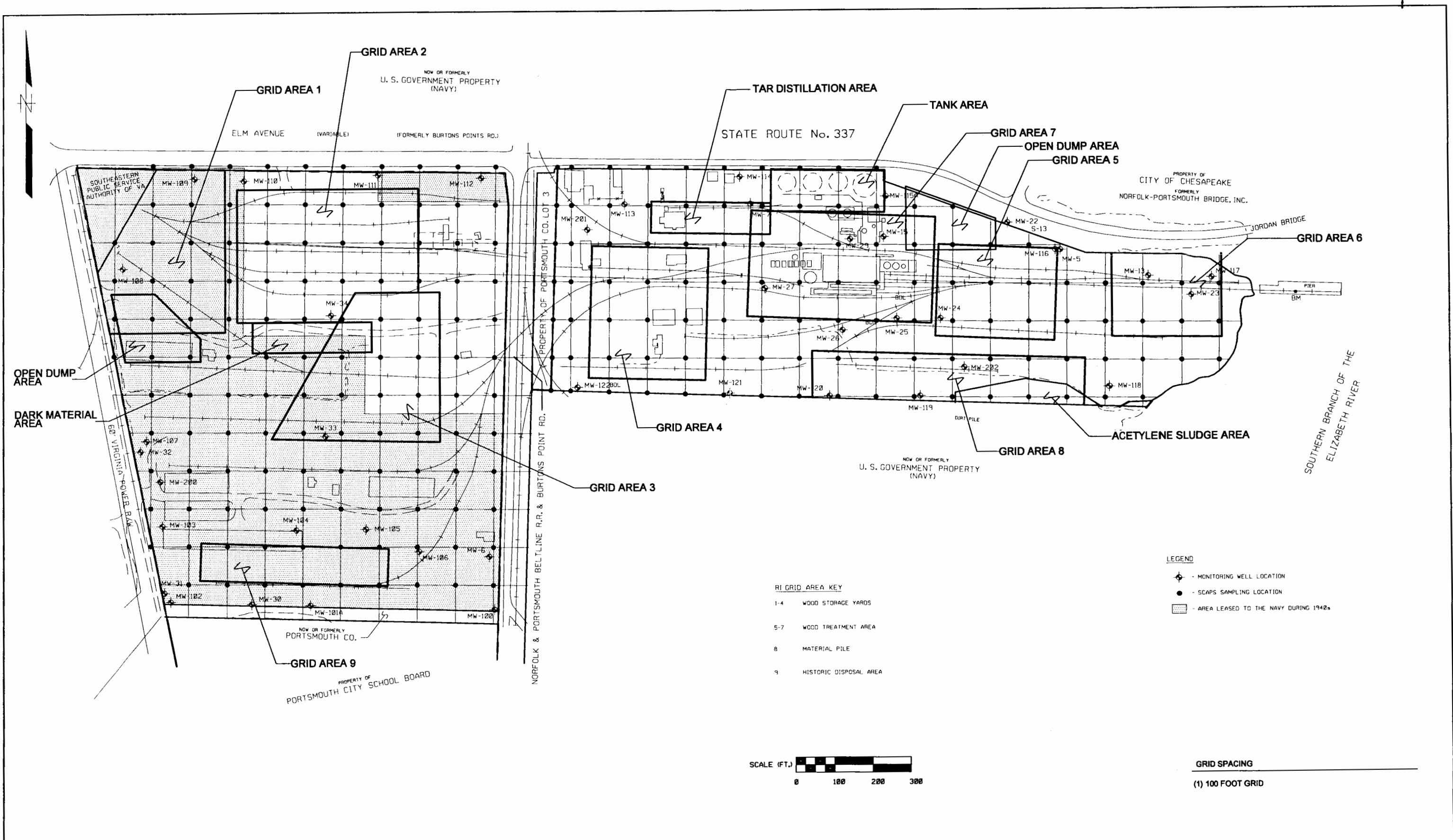


Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA SEDIMENT SAMPLE LOCATIONS	Dwg. No. FIGURE 4-7
Checked By:	Date:		
Approved By:	JAN. 2000		



Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA SITE MAP	Dwg. No. FIGURE 4-1
Checked By:	Date:		
Approved By:	JAN. 2000		

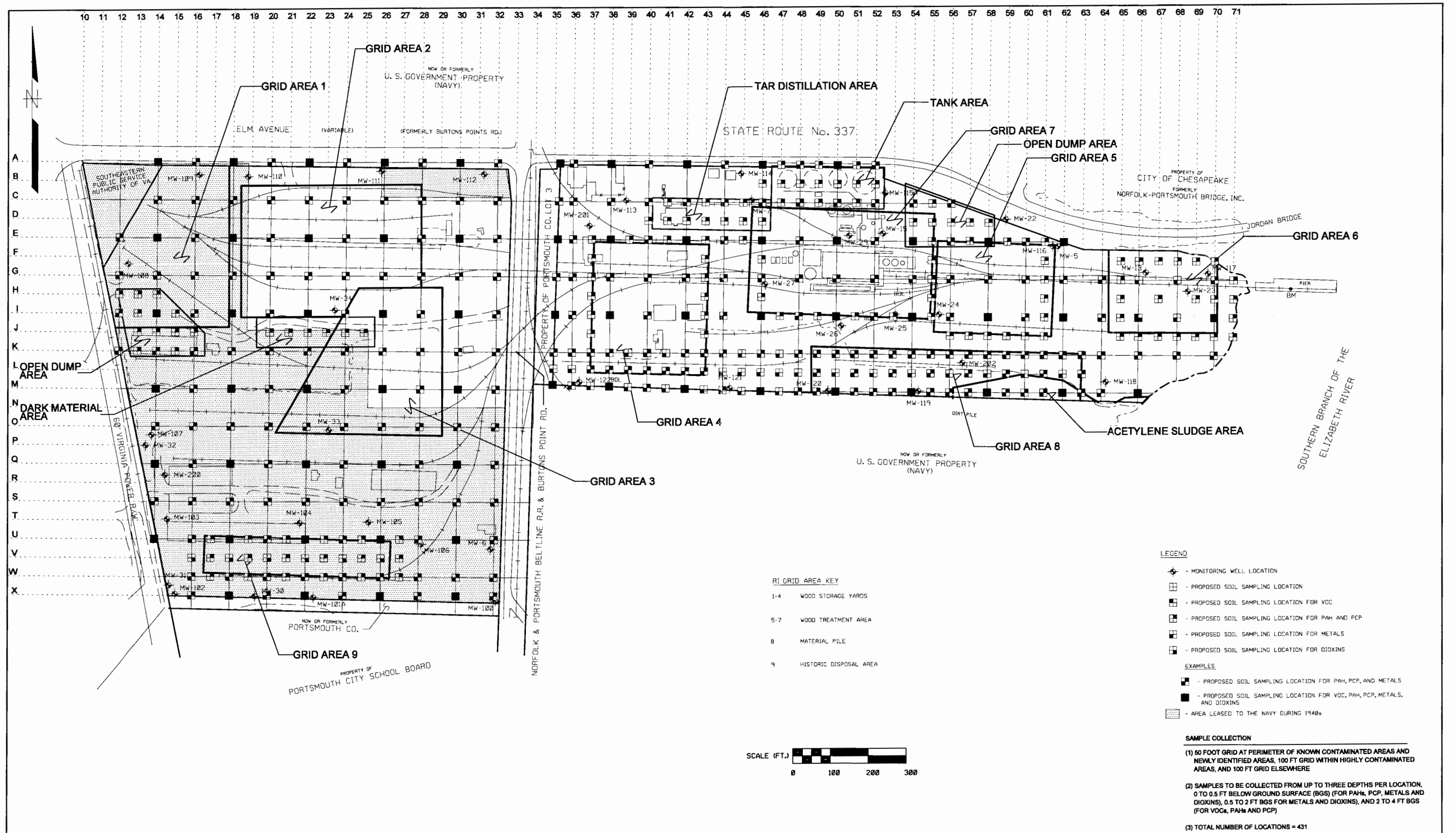




Drawn By:	JDB
Checked By:	
Approved By:	
Scale:	1" = 240'
Date:	JAN. 2000

ATLANTIC WOOD INDUSTRIES, INC.
PORTSMOUTH, VA
SCAPS SAMPLE LOCATIONS

Dwg. No.
FIGURE
4-6



Drawn By: JDB	Scale: 1"=240'	ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA VOC, PAH, PCP, METALS, AND DIOXIN SOIL SAMPLE LOCATIONS	Dwg. No. FIGURE 4-8
Checked By:	Date:		
Approved By:	JAN. 2000		

5.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

5.1 FIELD LOGBOOK

Sampling personnel will record daily activities in a field logbook. The logbook will contain specific information about field activities as described in CDM Federal SOP 4-1 (Appendix B) including: date; names and affiliation of all onsite personnel; description of all activities; problems or delays encountered while conducting sampling activities; and equipment and materials used during sampling activities. Any deviations from this Work Plan will be documented. The following guidelines will be employed in all field logbooks:

- The logbook itself will be permanently bound (not spiral bound), and all pages, front and back, will be consecutively numbered.
- The logbook will contain an account of daily activities, conversations with coordinating officials, descriptions of photographs taken during sampling, and field equipment calibration data.
- All entries will be written in blue or black indelible ink.
- The first page will contain a listing of key personnel and telephone numbers specific to that project.
- Each page will be dated and initialed.
- A new page will be started at the beginning of each day.
- Entries into the logbook will be chronological and time notation (using military time) will introduce each entry.

- The logbook will be signed at the end of each day. Signatures will be written on a single diagonal line drawn across the blank portion of the page following the day's last entry.
- If an error is made in the field logbook, it will be corrected by crossing a single line through the error and entering the correct information. All corrections will be dated and initialed, and will be corrected by the person who made the entry.

5.2 PHOTOGRAPHS

Photographs will be taken to visually document field activities and site features, as described in CDM Federal SOP 4-2 (Appendix B). All photographs will be recorded in the field logbook. The following are general guidelines to be used regarding photographs:

- Each photograph will have a full caption permanently attached to the back containing the following information: site, a brief description, date, time, direction, and photographer's name.
- A standard reference marker to indicate the feature size should be used when appropriate.

5.3 SAMPLE NUMBERING SYSTEM

A coding system will be used to identify each sample collected during the field phase of the project. This coding system will provide a tracking record to allow retrieval of information about a particular sample and ensure that each sample is uniquely identified.

Each sample is identified by a unique code which indicates the site identifier, sample type, sample point, and sequence number. The sample identification code will be different for

environmental and QC samples. A template identification code for environmental samples is as follows:

AABB-CC-DD-EE

Where AA indicates the site, BB indicates the sample type, CC indicates the horizontal sample grid location, DD indicates the vertical sample grid location, and EE indicates the sequence, or depth number, as explained below.

- A two letter designation (AA) will be used to identify the site. The site code will be used as an identifier for all samples collected. This code will be 01 for the Atlantic Wood Industries site. Additional codes will be developed for offsite properties as needed.
- A two letter designation (BB) will identify the specific type of sample being collected. The sample types which will be collected during the investigation include but are not limited to the following:

SS - Surface Soil Sample (unsaturated zone)

SB - Subsurface Soil Sample

SD - Sediment Sample

SV - Soil Sample for Verification of SCAPS Data

- A two digit number (CC) will be used to identify the horizontal component of the grid location. These numbers will begin with 01 and will be in sequential order.
- A single letter designation (DD) will be used to identify the vertical component of the grid location.

- A three digit number (EE) will be used as a sequence identifier. This number will identify separate samples collected at the same sample location, such as soil samples collected at the same location, but at different depths. This identifier will also be used to distinguish duplicates. Duplicate samples will be indicated by the use of a "9" in the first digit of this number. Samples for MS/MSD will be labeled the same as the original sample.

Therefore, example sample identifier 01SS-62-H-000 indicates that it is an Atlantic Wood Industries surface soil (unsaturated zone) sample collected from sample location 62H and it is collected from a top depth of 0 (ground surface). Whereas, 01SS-62-H-900 indicates that it is a duplicate sample collected from sample location 62H at ground surface.

QC samples will be identified with a different code than environmental samples. A template identification code for trip blank and source water blank QC samples is as follows:

AA-BBB

Where AA indicates the type of QC sample and BBB indicates the sample sequence number, as explained below.

- A two letter designation (AA) will be used to identify the specific type of QC sample being collected. The QC sample types that follow this code which will be collected during the investigation include but are not limited to the following:

TB - Trip Blank

WB - Source Water Blank

DI - High Purity Water Blank

- A three digit number (BBB) will be used as a sequence identifier. This number will start with 001 for the first sample of each sample type, 002 for the second sample of each sample type, etc.

Therefore, example sample identifier TB-004 indicates that it is the fourth trip blank collected during the field effort. Whereas, DI-001 indicates that it is a source blank from the first batch of high purity water.

A template identification code for equipment rinsate blank QC samples is as follows:

AABB-CCC

Where AA indicates the rinsate QC sample, BB indicates the type of rinsate blank, and CCC indicates the sample sequence number, as explained below.

- A two letter designation (AA) will be used to identify that the sample is a rinsate blank. This designation will be “RB” for all rinsate blanks.
- A two letter designation (BB) will be used to identify the type of sampling equipment that the rinsate is collected from. The types of sampling equipment that will require rinsate blanks collected during the investigation include but are not limited to the following:

SS - Surface Soil Sample (unsaturated zone)

SB - Subsurface Soil Sample

SD - Sediment Sample

- A three digit number (BBB) will be used as a sequence identifier. This number will start with 001 for the first rinsate sample of each sample equipment type, 002 for the second rinsate sample of each sample equipment type, etc.

Therefore, example sample identifier RBSD-004 indicates that it is the fourth sediment sample rinsate blank collected during the field effort. Whereas, RBSB-001 indicates that it is the first subsurface soil sample rinsate blank collected during the field effort.

5.4 SAMPLE DOCUMENTATION

5.4.1 SAMPLE LABELS

Sample labels are to be completed prior to collection of samples. The label will contain information on the site name, sample number, date, time of collection, type of analysis, preservative, sample type, and sampler signature. To prevent smearing, labels will be kept dry, and will be fixed to the container, utilizing a strip of acetate tape placed over the completed label with the tape completely surrounding the container. Care will be taken to ensure that the acetate tape does not cover the jar-lid interface to prevent the potential for solvents in the adhesive to permeate into the sample. After completing the information on the sample label and collecting the sample, the cap or lid will be tightly fastened.

5.4.2 FIELD LOGBOOK

During sampling, the field logbook will contain all information specific to the job site and sample, including the following: activity and project number, analyses requested, sample container type, preservatives used, date, time, and sampler's name and signature. Also, the field logbook will be hard bound and will be used to document the source of reagents (brand name and lot number). This will be in addition to the chain-of-custody record which accompanies the sample shipment.

5.4.3 CHAIN-OF-CUSTODY RECORDS

Sample custody procedures will be followed according to CDM Federal SOP 1-2 (Appendix B). Chain-of-custody forms will be used to identify and ensure the integrity of all samples that are shipped to the laboratory. A three-part chain-of-custody form will be used. The bottom copy will be removed from the form prior to shipment and will be retained in the project files. The original and second copies will be shipped to the laboratory with the samples. After analysis, the laboratory will return a signed copy of the chain-of-custody form with the analytical results. A chain-of-custody form will be completed for all samples (one or more for each cooler) and will accompany the samples to the laboratory. The chain-of-custody form will be placed in a zipper-top bag taped to the bottom of the lid inside the cooler.

Upon arrival of samples at the subcontractor laboratory, the condition of the samples will be inspected and a Cooler Receipt Form will be completed. The following procedures will be used by the subcontractor laboratory in maintaining the chain-of-custody record once the samples have been received:

- The samples received by the laboratory will be cross-checked to verify that the information on the sample labels matches that on the chain-of-custody form included with the shipment.
- The "received by laboratory" box will be signed and dated if all data and samples are correct, and there has been no tampering with the cooler custody seals.
- The samples will be stored or distributed to the appropriate analysts, with names of individuals who receive samples to be recorded in internal laboratory records.
- Final evidence files will be prepared by the subcontractor laboratory.

5.5 DOCUMENTATION PROCEDURES

See CDM Federal SOP 4-1 (Appendix B) and Section 5.1 “Field Logbook” for documentation procedures that will be followed during all field activities.

6.0 SAMPLE PACKAGING AND SHIPPING

Samples will be packed and shipped according to CDM Federal SOP 2-5 (Appendix B).

Samples will be shipped in metal (or equivalent strength plastic) ice chests or coolers only.

Coolers without drain plugs are preferred. If the cooler has a drain plug, the plug will be taped or otherwise fixed shut so that any liquids inside the cooler are not discharged during shipping or handling.

Each sample container will be placed in a plastic zipper-top bag. The seal on the zipper-top bag will be closed and the bag and container placed into a cooled ice chest. The coolers will be prepared for shipment by placing a large trash bag inside the cooler with approximately 3 inches of inert, cushioning material such as vermiculite on the bottom of the cooler. The containers will be placed upright in the cooler in such a way that they do not touch and do not have the potential for touching during shipment. Additional inert packing material will be placed in the cooler to partially cover each sample bottle (at least half way).

Ice will be placed in zipper-top bags. Bags containing ice will be sealed and placed into a second zipper-top bag. The double bags will minimize chances of leakage into the cooler. Enough ice bags will be used in the cooler to cover all the samples. The remainder of the cooler will be filled to the top with inert packing material.

All chain-of-custody paperwork will be completed by CDM Federal field staff. Paperwork will be placed in a plastic bag and taped to the inside lid of the cooler.

The cooler drain will be checked to ensure that it is taped shut. The lid of the cooler will be secured with strapping tape. The cooler will be completely wrapped with strapping tape at a minimum of two locations. The tape will not cover any labels.

The completed shipping label will be attached to the top of the cooler. A "This Side Up" label will be affixed to all four sides. Two signed custody seals will be affixed on the front and back of the cooler so that one would have to be broken to open the cooler. Custody seals will be covered with acetate tape.

All samples will be shipped via overnight express. An air bill will be completed for each cooler. Each air bill represents possession and receipt of samples (chain-of-custody) for the samples in each cooler. Air bill numbers will be recorded in the field logbook for each set of samples shipped to the subcontract laboratory.

7.0 INVESTIGATION-DERIVED WASTES (IDW)

This section describes the procedures for management and disposal of investigation-derived waste (IDW) generated during PRDI field activities at AWI. This section identifies waste types, waste management tracking, containerization, labeling, staging, and sampling of IDW. The approach outlined emphasizes the following objectives:

- Management of IDW in a manner that is protective to human health and the environment.
- Minimization of IDW generation, thereby reducing costs for storage and disposal.
- Compliance with federal and state regulatory requirements.

7.1 TYPES AND QUANTITIES OF INVESTIGATION-DERIVED WASTE

A variety of potentially contaminated and noncontaminated wastes will be generated during the field investigation. The types and estimated quantities of IDW are discussed below.

Decontamination Water

Decontamination water will be generated during cleaning of soil and sediment sample equipment and the SCAPS rig. Decontamination water will contain Liquinox (soap used in decontamination) and may contain contaminants that are potentially present in the area under investigation. Decontamination water will be transferred and stored in Department of Transportation (DOT)-approved 55-gallon drums or in larger carboys. The total estimated quantity of decontamination water to be produced is the equivalent of 60 55-gallon drums.

Soil Cuttings

Soil cuttings will be generated from geoprobe sampling below the water table during SCAPS verification soil sampling activities. These cuttings will be transferred and stored in DOT-approved 55-gallon drums. The total estimated quantity of soil cuttings to be produced is eight 55-gallon drums.

Personal Protective Equipment

Personal protective equipment (PPE) will be worn as specified in the SSHP. PPE wastes will consist of latex gloves, vinyl gloves, tyvex suits and overboots. This material will be double-bagged using large trash bags and placed into an onsite trash dumpster for subsequent disposal in a minimum technology Subtitle D disposal facility.

Noncontaminated IDW

All "clean trash" (i.e., trash that is not chemically contaminated) will be segregated and disposed of in an onsite trash dumpster for subsequent disposal in a minimum technology Subtitle D disposal facility. Examples of clean trash are office paper, aluminum cans, drink bottles, other glass bottles not used to store potentially hazardous chemicals, aluminum foil, food items, and other items not regarded as potentially hazardous.

Other Chemical Use

Chemicals for the decontamination of equipment and the preservation of samples will also be used onsite and will be segregated from the decontamination water. These chemicals will include waste isopropanol and water (used in decontamination), and waste nitric acid and water (used in decontamination and as sample preservative). The total quantities expected to be generated during the investigation are shown below:

- Isopropanol Wastewater - four 55-gallon drums (hazardous)
- Nitric Acid Wastewater - four 55-gallon drums (hazardous)

7.1.1 WASTE MANAGEMENT TRACKING

Information on all IDW drums and carboys will be documented in the field logbook. This information will include the following:

- Type of waste
- Date waste was first placed in drum
- IDW drum number
- Location where the waste was generated
- Comments

The CDM Federal SC will be responsible for: IDW tracking during field activities, ensuring that all procedures are conducted in accordance with this FSP; maintaining communications with AWI regarding IDW issues; and directing activities of CDM Federal subcontractors involved in the generation, management, and disposal of IDW.

7.1.2 CONTAINER LABELING

IDW designated drums or carboys will be labeled to ensure proper management of the waste. The drums will be numbered so that they can be easily tracked. The following information will be recorded on IDW drums using a paint pen:

- Project name
- IDW drum number
- Brief description of the contents, such as "Decontamination Water"
- Location where the waste was generated
- Date that waste was first placed in the container

7.1.3 STAGING

An IDW staging area will be identified by AWI prior to the start of field activities. Movement of IDW to the staging area will be coordinated by the CDM Federal SC. Drums will be allowed to remain at the location of use until full, at which time drums will be transported to the staging area.

7.1.4 CHARACTERIZATION

IDW generated during the field activities will be temporarily stored at the staging area pending final classification of material by type of waste. The determination will be based on characterization samples collected at the conclusion of the field work. The number and types of characterization samples, as well as disposal of IDW, will be determined by the IDW disposal subcontractor. IDW characterization and disposal to be performed by the IDW subcontractors will be approved by USACE. Options may include treatment of selected IDW at the AWI onsite carbon unit.

8.0 CONTRACTOR CHEMICAL QUALITY CONTROL (CCQC)

Contractor Chemical Quality Control (CCQC) is a three-phase QC process designed to ensure compliance with applicable QC standards in all phases of the field effort. It is comprised of a preparatory, initial, and follow-up phase, and includes checklists for each phase. CDM Federal will utilize the CCQC measures specified in Appendix H of USACE document EM-200-1-3 throughout the field effort.

Preparatory Phase

During the preparatory phase, a project checklist will be developed that reflects anticipated site conditions. The checklist will be used to verify that project tasks are being performed at specified intervals during the project and will include information important to the successful completion of the field effort (e.g., field equipment and supplies, subcontractor plans, instrument operating manuals).

Initial Phase Checklist of Activities

Sampling activities will be overseen and a review of the work for compliance with contract requirements will be performed by the contract quality control (CQC) representative. This will be accomplished, in part, by the two field QA audits, as described in Section 13.0 of the QAPP.

Follow-up Phase

It will be the responsibility of the CQC representative for continued daily contract compliance throughout the course of the project.

9.0 DAILY CHEMICAL QUALITY CONTROL REPORTS (DCQCR)

DCQCRs will be completed daily during field activities and submitted at the end of each week to the USACE, Baltimore District, Design Manager. The DCQCRs will include the subcontractors and equipment onsite; work performed (including samples collected and shipped); quality control activities; health and safety levels and activities; problems encountered and corrective action measures taken; and anticipated activities for the next day. A copy of the DCQCR form is included in Appendix C (Field Forms). Minor deviations from the approved Work Plan will be documented on the DCQCR form so that the USACE Design Manager is aware of these field changes. Major deviations will require USACE Design Manager approval prior to implementation.

10.0 CORRECTIVE ACTIONS

10.1 FIELD AND OFFICE CORRECTIVE ACTION

10.1.1 INITIATION OF CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, evaluated, and corrected.

When a significant condition adverse to quality is noted at the site or in the office, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the SC, PM, QAD or designee, involved subcontractor management (if applicable), and the USACE Project Manager. Implementation of corrective action is verified by a follow-up review. All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality.

The following corrective actions may be initiated, at a minimum:

- When procedures or data compiled are determined to be faulty;
- When equipment or instrumentation is determined to be faulty and can impact quality;
- When samples and test results are questionably traceable and suspect;
- When QA/QC requirements have been violated;

- When designated approvals have been circumvented;
- As a result of system and/or performance audits;
- As a result of a management assessment; and
- As a result of laboratory/inter-laboratory comparison studies.

Notices of any corrective actions needed and/or resolved will be documented and sent to appropriate CDM Federal management.

10.1.2 PROCEDURE DESCRIPTION

Project management and staff, such as the SC, field investigation teams, and QA auditors will monitor ongoing work performance in the normal course of their daily responsibilities.

Work may be audited at the site, at laboratories, and at subcontractor locations by the QAD and/or designated alternate. Items, activities, or documents not in compliance with QA requirements, as well as any corrective actions mandated, will be documented and brought to the attention of the PM. Audit findings and corrective actions are logged, maintained, and controlled by the QAD. Corrective action will be a closed-looped system with the PM notifying the QAD that corrective actions have been implemented, followed by the QAD verifying this action. Verification or implementation of a corrective action will be documented in writing by the QAD to the PM.

11.0 PROJECT SCHEDULE

It is estimated that the PRDI will be completed within 16 months from the notice to proceed (NTP). This will include all activities associated with the planning and implementation of field activities, data receipt, data validation, development of an analytical database system, submittal of the Draft and Final SCAPS and PRDI Reports, and submittal of the Final Summary and Recommendations Report. Figure 11-1 shows the anticipated schedule for critical portions of the PRDI. Tasks identified in the project schedule follow those developed in the Technical Approach and Cost Proposal submitted by CDM Federal on 29 December 1998, plus planned future tasks anticipated to be completed.

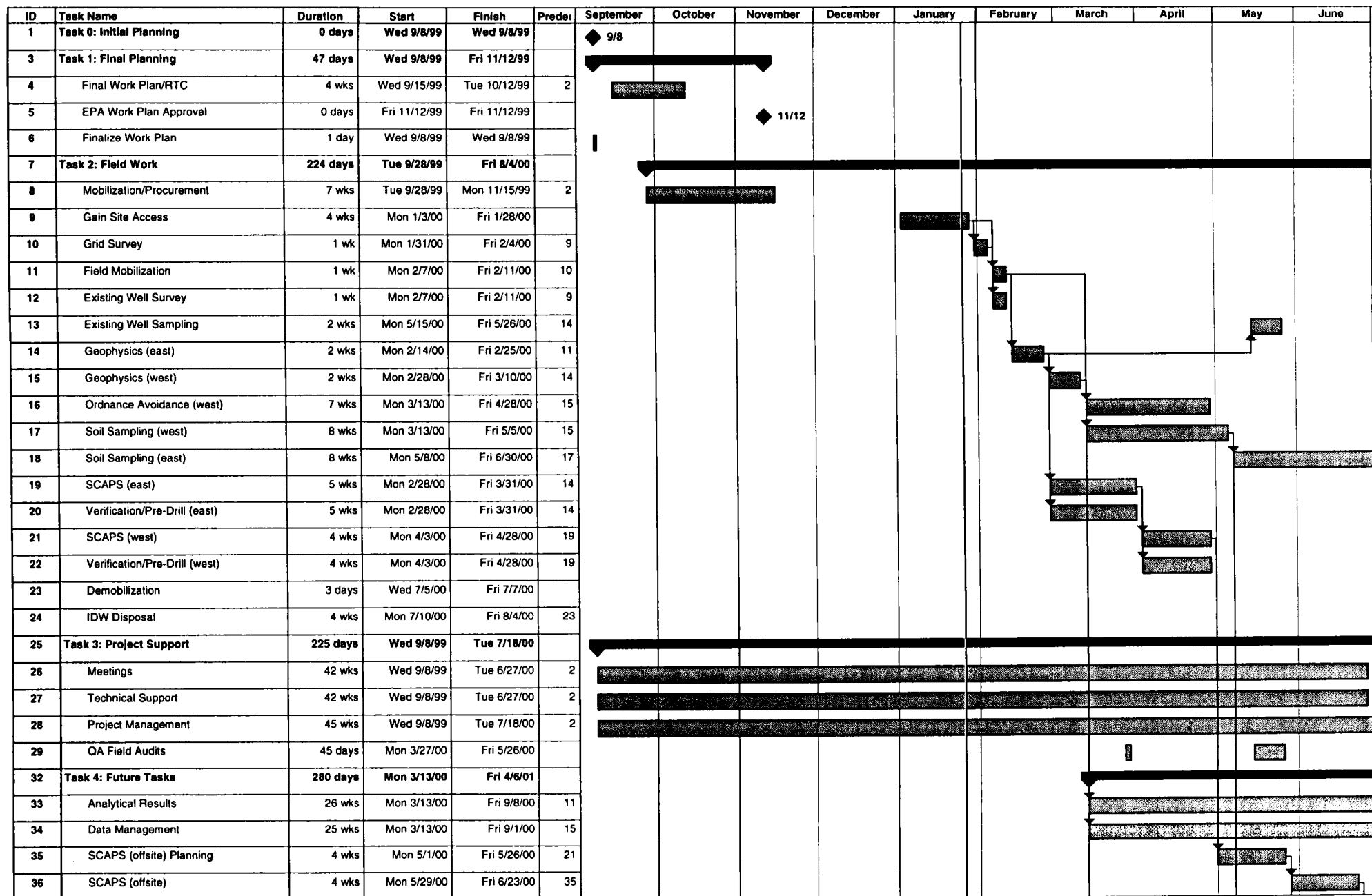
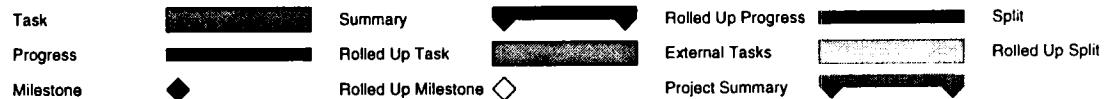


Figure 11-1
Project Schedule
AWI Superfund Site PRDI



ID	Task Name	Duration	Start	Finish	Predecessor	September	October	November	December	January	February	March	April	May	June
37	Verification/Pre-Drill (offsite)	4 wks	Mon 5/29/00	Fri 6/23/00	35										
38	Data Validation	12 wks	Mon 6/26/00	Fri 9/15/00	37										
39	GMS Entry	30 wks	Mon 3/13/00	Fri 10/6/00	11										
40	Draft SCAPS Report	4 wks	Mon 6/26/00	Fri 7/21/00	36										
41	Agency Review	4 wks	Mon 7/24/00	Fri 8/18/00	40										
42	PRP Review	4 wks	Mon 7/24/00	Fri 8/18/00	40										
43	Draft Final SCAPS Report	4 wks	Mon 8/21/00	Fri 9/15/00	42										
44	Agency Review	4 wks	Mon 9/18/00	Fri 10/13/00	43										
45	PRP Review	4 wks	Mon 9/18/00	Fri 10/13/00	43										
46	Final SCAPS Report	4 wks	Mon 10/16/00	Fri 11/10/00	45										
47	Draft Offsite SCAPS Report	4 wks	Mon 11/13/00	Fri 12/8/00	46										
48	Agency Review	4 wks	Mon 12/11/00	Fri 1/5/01	47										
49	PRP Review	4 wks	Mon 12/11/00	Fri 1/5/01	47										
50	Draft Final Offsite SCAPS Report	4 wks	Mon 1/8/01	Fri 2/2/01	49										
51	Agency Review	4 wks	Mon 2/5/01	Fri 3/2/01	50										
52	PRP Review	4 wks	Mon 2/5/01	Fri 3/2/01	50										
53	Final Offsite SCAPS Report	4 wks	Mon 3/5/01	Fri 3/30/01	52										
54	Draft PRDI Report	12 wks	Mon 9/18/00	Fri 12/8/00	38										
55	Agency Review	4 wks	Mon 12/11/00	Fri 1/5/01	54										
56	PRP Review	4 wks	Mon 12/11/00	Fri 1/5/01	54										
57	Draft Final PRDI Report	4 wks	Mon 1/8/01	Fri 2/2/01	56										
58	Agency Review	4 wks	Mon 2/5/01	Fri 3/2/01	57										
59	PRP Review	4 wks	Mon 2/5/01	Fri 3/2/01	57										
60	Final PRDI Report	4 wks	Mon 3/5/01	Fri 3/30/01	59										
61	QA Office Audit	1 wk	Mon 4/2/01	Fri 4/6/01	60										
62	Draft Final Summary/Recom. Report	8 wks	Mon 5/8/00	Fri 6/30/00	17										
63	Agency Review	8 wks	Mon 7/3/00	Fri 8/25/00	62										
64	PRP Review	8 wks	Mon 7/3/00	Fri 8/25/00	62										
65	Final Summary/Recom. Report	4 wks	Mon 8/28/00	Fri 9/22/00	64										
66	Meetings	28 wks	Wed 7/19/00	Tue 1/30/01	28										
67	Technical Support	28 wks	Wed 7/19/00	Tue 1/30/01	28										
68	Project Management	28 wks	Wed 7/19/00	Tue 1/30/01	28										

Figure 11-1
Project Schedule
AWI Superfund Site PRDI



ID	Task Name	Duration	Start	Finish	July	August	September	October	November	December	January	February	March	April
1	Task 0: Initial Planning	0 days	Wed 9/8/99	Wed 9/8/99										
3	Task 1: Final Planning	47 days	Wed 9/8/99	Fri 11/12/99										
4	Final Work Plan/RTC	4 wks	Wed 9/15/99	Tue 10/12/99										
5	EPA Work Plan Approval	0 days	Fri 11/12/99	Fri 11/12/99										
6	Finalize Work Plan	1 day	Wed 9/8/99	Wed 9/8/99										
7	Task 2: Field Work	224 days	Tue 9/28/99	Fri 8/4/00										
8	Mobilization/Procurement	7 wks	Tue 9/28/99	Mon 11/15/99										
9	Gain Site Access	4 wks	Mon 1/3/00	Fri 1/28/00										
10	Grid Survey	1 wk	Mon 1/31/00	Fri 2/4/00										
11	Field Mobilization	1 wk	Mon 2/7/00	Fri 2/11/00										
12	Existing Well Survey	1 wk	Mon 2/7/00	Fri 2/11/00										
13	Existing Well Sampling	2 wks	Mon 5/15/00	Fri 5/26/00										
14	Geophysics (east)	2 wks	Mon 2/14/00	Fri 2/25/00										
15	Geophysics (west)	2 wks	Mon 2/28/00	Fri 3/10/00										
16	Ordnance Avoidance (west)	7 wks	Mon 3/13/00	Fri 4/28/00										
17	Soil Sampling (west)	8 wks	Mon 3/13/00	Fri 5/5/00										
18	Soil Sampling (east)	8 wks	Mon 5/8/00	Fri 6/30/00										
19	SCAPS (east)	5 wks	Mon 2/28/00	Fri 3/31/00										
20	Verification/Pre-Drill (east)	5 wks	Mon 2/28/00	Fri 3/31/00										
21	SCAPS (west)	4 wks	Mon 4/3/00	Fri 4/28/00										
22	Verification/Pre-Drill (west)	4 wks	Mon 4/3/00	Fri 4/28/00										
23	Demobilization	3 days	Wed 7/5/00	Fri 7/7/00										
24	IDW Disposal	4 wks	Mon 7/10/00	Fri 8/4/00										
25	Task 3: Project Support	225 days	Wed 9/8/99	Tue 7/18/00										
26	Meetings	42 wks	Wed 9/8/99	Tue 6/27/00										
27	Technical Support	42 wks	Wed 9/8/99	Tue 6/27/00										
28	Project Management	45 wks	Wed 9/8/99	Tue 7/18/00										
29	QA Field Audits	45 days	Mon 3/27/00	Fri 5/26/00										
32	Task 4: Future Tasks	280 days	Mon 3/13/00	Fri 4/6/01										
33	Analytical Results	26 wks	Mon 3/13/00	Fri 9/8/00										
34	Data Management	25 wks	Mon 3/13/00	Fri 9/1/00										
35	SCAPS (offsite) Planning	4 wks	Mon 5/1/00	Fri 5/26/00										
36	SCAPS (offsite)	4 wks	Mon 5/29/00	Fri 6/23/00										

Figure 11-1
Project Schedule
AWI Superfund Site PRDI

Task		Summary		Rolled Up Progress		Split	
Progress		Rolled Up Task		External Tasks		Rolled Up Split	
Milestone		Rolled Up Milestone		Project Summary			

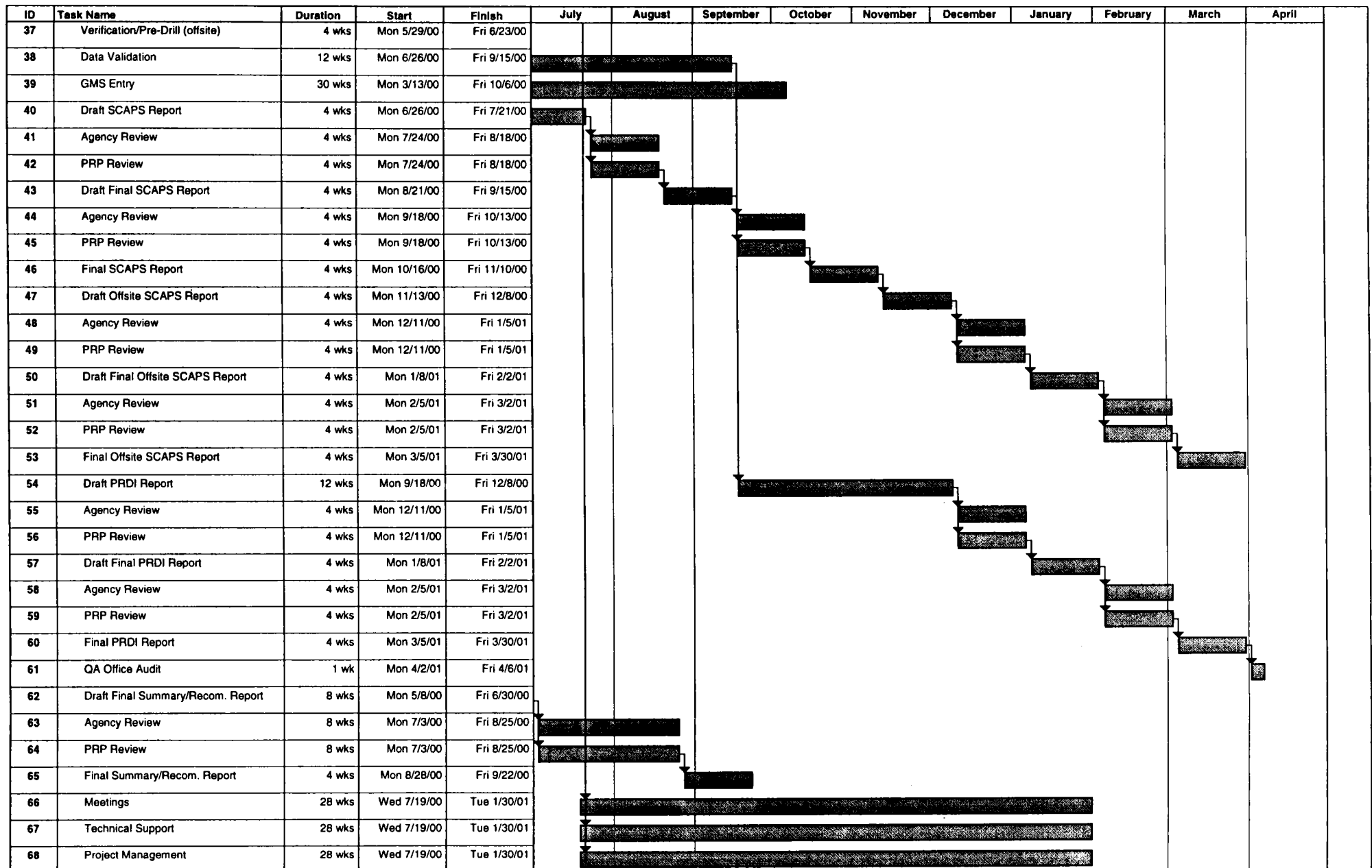


Figure 11-1
Project Schedule
AWI Superfund Site PRDI



**List of CDM Federal Standard Operating Procedures and Equipment Procedures
for AWI Pre-Remedial Design Investigation**

<u>SOP NUMBER</u>	<u>NAME</u>	<u>DATE</u>	<u>PAGES</u>
1-1	Surface Water and Sediment/Sludge Sampling	2/18/99	15
1-2	Sample Custody	6/30/94	8
1-3	Surface Soil Sampling	2/18/99	13
1-4	Subsurface Soil Sampling	4/6/99	21
1-6	Water Level Measurement	11/15/95	9
1-10	Field Measurement of Organic Vapors	9/30/96	4
2-5	Packaging and Shipping Environmental Samples	11/15/95	4
2-6	Guide to Handling Investigation-Derived Waste	2/18/99	10
3-1	Geoprobe Sampling	6/14/95	17
3-3	Magnetometer Survey	4/6/96	8
3-5	Lithologic Logging	2/18/99	23
4-1	Field Logbook Content and Control	2/18/99	5
4-2	Photographic Documentation of Field Activities	2/18/99	9
4-5	Field Decontamination at Nonradioactive Sites	3/13/98	8
5-1	Control of Measurement and Test Equipment	3/13/98	7

<u>EP NUMBER</u>	<u>NAME</u>	<u>DATE</u>	<u>PAGES</u>
C.2	OVM/DataLogger, Model 580B	NA	30
C.3	HNU Model PI-101/Photoionization Analyzer	NA	26

FIELD SAMPLING PLAN

APPENDIX B

CDM FEDERAL STANDARD OPERATING PROCEDURES AND EQUIPMENT PROCEDURES

REFERENCES

American Society for Testing and Materials (ASTM), Annual Book of Standards, Current Edition.

CDM Federal Programs Corporation (CDM Federal), Draft Summary and Recommendations Report, Pre-Remedial Design Investigation, Atlantic Wood Industries, Inc. Superfund Site, Portsmouth, Virginia, April 1998.

CDM Federal, Technical Operating Procedures (SOPs), 1999.

Keystone Environmental Resources, Inc., Remedial Investigation Report of Atlantic Wood Industries, Inc. Portsmouth, Virginia Site, January 1992.

U.S. Army Corps of Engineers (USACE), Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, September 1994.

USACE, Chemical Quality Assurance for HTRW Projects, EM 200-1-6, 10 October 1997.

USACE, Shell for Analytical Chemistry Requirements, Version 1.0, 2 November 1998.

U.S. Environmental Protection Agency (USEPA), Environmental Monitoring Systems Laboratory, Site Analysis (Historical Aerial Photographs), Atlantic Wood Industries, Portsmouth, Virginia, Interim Report, TS-PIC-89110, December 1989.

USEPA, Record of Decision, Operable Unit 1 (Soil, Sediment, DNAPL), Atlantic Wood Industries, Inc. Superfund Site, City of Portsmouth, Virginia, September 1995.

USEPA, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Current Edition.

FIELD SAMPLING PLAN

APPENDIX A

REFERENCES

SURFACE WATER AND SEDIMENT/ SLUDGE SAMPLING

SOP 1-1

Revision: 4

Date: February 18, 1999

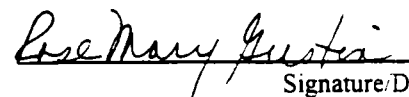
Page 1 of 15

Prepared: Del Baird

Technical Review: Mitchell Goldberg

QA Review: David O. Johnson

Approved:  2/24/99
Signature/Date

Issued:  2/24/99
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define requirements for collection and containment of surface water and sediment/sludge samples.

2.0 BACKGROUND

2.1 Definitions

Surface Water - Water that flows over or rests on the land and is open to the atmosphere. This includes ditches, streams, rivers, lakes, pools, ponds, and basins.

Shallow Surface Water - Water within 1 to 3 feet of the surface of a body of water.

Deep Surface Water - Water deeper than 3 feet of the surface of a body of water.

Sediment - Geologic and/or organic material underlying a body of water. The material has been transported by a fluid and deposited within the boundaries of the body of water.

Sludge - Materials ranging in type from dewatered solids to high viscosity liquids. The material may exist suspended throughout the water or settled from the water as all or part of the sediment.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Composite - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, then a single average sample is taken from the mixture.

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2.2 Discussion

The SOPs for collection of surface water and sediment/sludge samples have been combined into one SOP since samples of these matrices are often collected at the same time given that sediment/sludge samples are normally found by or under surface water bodies.

Both surface water and sediment/sludge samples are collected to determine the type(s) and level(s) of contamination in a particular surface water body and/or its biological disposition; however, sediment/sludge samples will provide a more historical account of contamination than will water samples due to the nature of the matrix.

2.3 Associated Procedures

- CDM Federal SOP 1-2, Sample Custody
- CDM Federal SOP 2-5, Packaging and Shipping of Environmental Samples
- CDM Federal SOP 4-1, Field Logbook Content and Control
- CDM Federal SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

Field Team Leader - The Field Team Leader (FTL) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling. The FTL also must ensure that the quantity and location of surface water and/or sediment/sludge samples collected meet the requirements of the site-specific plans.

4.0 REQUIRED EQUIPMENT

All or part of the equipment listed under the "as needed" category may be required at any specific site, depending on the plan(s) for that site.

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- Site-specific plans
- Field logbook
- Indelible black-ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Appropriate sample containers
- Insulated cooler and waterproof sealing tape
- Ice bags or "blue ice"
- Plastic zip-top bags
- Clear waterproof tape
- Personal protective clothing and equipment
- Latex or appropriate gloves
- Rubber boots and/or rubberized waders
- Stainless steel or Teflon spoons, spatulas, or scoops
- Teflon or stainless steel mixing bowls or trays

As needed:

- Pond sampler with 1-L beaker (preferably Teflon), clamp, and heavy-duty telescoping pole
- Weighted bottle sampler, 1-L capacity (preferably Teflon); a Kemmerer or Van Dorn sampler may be used if Teflon is not required
- Teflon or stainless steel bailers
- Hand or gravity corer with extensions or stainless steel hand auger
- Core liners of Teflon, stainless steel, brass, aluminum, or polybutyrate, as specified in the site-specific plan(s)
- Stainless steel push tubes
- Peristaltic pump or suitable replacement
- Dredge (e.g., Peterson, Eckman, Ponar)
- Temperature, pH, and conductivity meter(s), dissolved oxygen meter
- Boat for deep water or inaccessible shorelines
- Hand held Ground Positioning System (GPS)
- Tape Measure
- Any personal protective equipment specified in the site-specific health and safety plan

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9. Decontaminate reusable sampling equipment after sample collection according to CDM Federal SOP 4-5.
10. Processes for verifying depth of samples must be included in site-specific project plans.
11. Check that a trip blank, when necessary, is included in the chilled cooler.

5.2 Shallow Surface Water Sample Collection

5.2.1 Method for Collecting Samples for Volatile Organic Analysis

The following steps must be taken when collecting shallow surface water volatile organic compound (VOC) samples:

If the volatile organic analysis (VOA) vials do not require a preservative:

1. Approach the sample location from downstream, and do not enter the sample area. Slowly submerge VOA vials completely into an area of gently flowing water and fill. Do not disturb bottom sediments. The sampler and open end of the vials should be pointed upstream. If wading is necessary, approach the sample location from downstream and do not enter the actual sample area.

NOTE: When collecting VOCs, avoid collect from a surface water point where water is cascading and aerating.

2. Cap the VOA vial while it is underwater. Be sure to dislodge all air bubbles from the cap before sealing the vial.
3. Turn the capped vial upside-down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.
4. Proceed to Step 5 below.

If the VOA vials require a preservative:

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1. Collect a sufficient sample in a clean glass jar as in Steps 1 and 2 above for unpreserved vials. Specific sampling devices to be used must be specified in site-specific plans.
2. Decant the sample immediately into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Tip vials slightly while filling to reduce turbulence until nearly filled. Then straighten vial to vertical for final filling. Ensure that a meniscus is raised above the lip of the vial before capping.
3. Cap each vial once the meniscus has formed.
4. Turn the capped vial upside-down and check for air bubbles. Tap the bottom of the vials to dislodge any bubbles that may have formed around the cap or sides. Discard and resample if bubbles are present.
5. Wipe the outside of sample vials with a Kimwipe or clean paper towel.
6. Place sample vial(s) in a zip-top plastic bag and seal the bag.
7. Immediately pack all samples into a chilled cooler.

5.2.2 Method for Collecting Shallow Surface Water Samples for Nonvolatile Organic or Inorganic Analysis

The following steps must be followed when collecting shallow surface water samples for nonvolatile organic or inorganic analysis:

1. Directly dip the sample container, with the opening facing upstream, into the surface water and fill. If wading is necessary, approach the sample location from downstream and do not enter the actual sample area. Do not disturb underlying sediments.
2. If composite samples are desired, the samples may be pooled into a stainless steel glass, Teflon, or appropriate container, and decanted into sample containers. Filter samples if required by the site-specific plan.
3. Add appropriate preservatives to the sample containers if required, and check pH.

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NOTE: Use a separate container when field testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

4. Cap the sample containers and wipe the outer surfaces of the sample containers clean with a Kimwipe or clean paper towel.
5. Place sample container(s) in individual zip-top plastic bags, if possible, and seal the bags.
6. Water level/sample level may be marked on container to determine whether or not liquid is lost during storage and shipping.

NOTE: Marking of VOA vials is not necessary.

7. Immediately pack all samples into a chilled cooler.

5.3 Deep Surface Water Sample Collection

5.3.1 Method for Collecting Samples at Specified Depth Using a Weighted Bottle Sampler

The following steps must be followed when collecting surface water samples at specified depth using a weighted bottle sampler:

1. Lower the weighted bottle sampler to the depth specified in the site-specific plan.
2. Remove the stopper by pulling on the sampler line; allow the sampler to fill with water.
3. Release the sampler line to reseal the stopper and retrieve the sampler to the surface.
4. Wipe the weighted bottle sampler dry with a Kimwipe or clean paper towel.
5. Remove the stopper slowly. Fill the specified number of sample containers by slightly tipping the sampler against each sample bottle. Samples to be used for VOC analysis should be decanted directly from the sampler first into prepreserved VOA vials. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently discarded. Add appropriate preservatives to the other sample containers and check pH. Samples may be pooled in stainless steel, glass or Teflon containers to obtain the necessary volumes. Filter

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samples if required. Collect sample in separate container for pH, conductivity, temperature, and other measurements if necessary.

6. Close each sample container with the Teflon-lined cap once it is filled. Check for air bubbles in the VOC samples. If bubbles are present, discard and resample.
7. Wipe the outside of the sample containers clean with a Kimwipe or clean paper towel.
8. Place sample container(s), if possible, in individual zip-top plastic bags, and seal the bags.
9. Immediately pack all samples into a chilled cooler.

5.3.2 Method for Deep Surface Water Sample Collection Using a Peristaltic Pump

The following steps must be followed when collecting deep surface water samples using a peristaltic pump:

1. Install clean medical-grade silicon or Teflon tubing on the pump head. Leave sufficient tubing on the discharge side for convenient dispensing of liquid directly into sample containers.
2. Select the appropriate length of Teflon intake tubing necessary to reach the specified sampling depth. Attach the intake sampling tube to the intake pump tube.
3. Lower the intake tube into the surface water at the specified sampling location to the specified depth, making sure the end of the intake tube does not touch underlying sediments.
4. Start the pump and allow at least three tubing volumes of liquid to flow through and rinse the system before collecting any samples. Do not immediately dispense the purged liquid back to the surface water body. Instead, collect the purged liquid and return it to the source after sample collection is complete.
5. Fill the specified number of sample containers directly from the discharge line. Filter samples if required by the site-specific plan. While filling, allow the liquid to flow gently down the inside of the sample bottle to minimize turbulence. For VOC samples, fill prepreserved VOA vials and allow a meniscus to form above the top of the container before capping. It is recommended that the amount of preservative be predetermined on a separate aliquot of sample that is subsequently

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discarded. Check VOA vials to ensure that there are no air bubbles. Add appropriate preservatives to the other samples and check pH.

NOTE: Use a separate container when field testing pH, conductivity, temperature, etc. Do not insert pH paper or probe directly into sample container.

6. Cap the sample container(s). Wipe the outside of sample containers clean with a Kimwipe or clean paper towel.
7. Place sample container(s) in individual zip-top plastic bags and seal the bags.
8. Immediately pack all samples into a chilled cooler.
9. Drain the pump system; rinse it with deionized water, and wipe it dry. Replace all tubing with new tubing before sampling at another sampling location. Place all used tubing in plastic bags to be discarded or decontaminated according to the site-specific plans.

5.4 Sediment/Sludge Sample Collection from Shallow Waters

5.4.1 Method for Collecting Samples for Volatile Organic Analysis

The following steps must be followed when collecting shallow water sediment/sludge VOC samples:

1. Use a decontaminated stainless steel or Teflon, long-handled scoop, corer, push tube, or dredge to collect the entire sample in one grab. If wading is necessary, approach the sample location from downstream and do not enter the actual sample area.
2. Retrieve the sampling device, and slowly decant off any liquid phase.
3. Immediately fill the specified sample container(s) with the solid. Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no head space.

NOTE: Samples to be analyzed for VOC or other compounds degraded by aeration should be taken as grab samples. Do not homogenize or composite these samples.

4. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the container clean with a Kimwipe or clean paper towel.

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5. Place the sample container(s) in individual zip-top plastic bags, and seal the bags.
6. Immediately pack all samples into a chilled cooler.

5.4.2 Method for Collecting Samples for Nonvolatile Organic and Inorganic Analysis

The following steps must be taken when collecting shallow water sediment/sludge samples for analytes not degraded by aeration:

1. Collect sufficient volume to fill specified sample containers using decontaminated stainless steel or Teflon-lined equipment (scoops, corer, dredge sampler, etc.). If wading is necessary, approach the sample location from downstream and do not enter the actual sample area.
2. Retrieve the sampling device with the sample and slowly decant off any liquid phase.
3. Pool and homogenize samples in a stainless steel, Teflon, or appropriate pan or mixing bowl, using stainless steel spatula or spoon.
4. Fill each sample container with the homogenized sample to approximately 75-90% capacity, filling sample containers for organics analyses first.
5. Once each container is filled, close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel.
6. Place the sample container(s) in individual zip-top plastic bags, and seal the bags.
7. Immediately pack all samples into a chilled cooler.

5.5 Subsurface Sediment/Sludge Sample Collection Using a Corer or Auger from Shallow Waters

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5.5.1 Method for Collecting Samples for Volatile Organic Analysis Using an Unlined Corer (also applies to augers)

The following steps must be taken when collecting subsurface sediment/sludge VOC samples that underlie shallow water:

1. At the specified sampling location, force or drive the corer to the specified depth.
2. Twist and withdraw the corer in a smooth motion.
3. Retrieve the sampling device; remove the corer nosepiece (if possible) and extrude the sample into the specified sampling container(s). Use a clean stainless steel or Teflon spoon or spatula to completely fill the container(s), ensuring no headspace.
4. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of the sample container clean with a Kimwipe or clean paper towel.
5. Place the sample container(s) in individual zip-top plastic bags, and seal the bags.
6. Immediately pack all samples into a chilled cooler.

5.5.2 Method for Collecting Samples for Volatile Organic Analysis Using a Lined Corer

The following steps must be followed when collecting shallow water subsurface sediment/sludge VOC samples that underlie shallow water:

1. Install decontaminated liner(s) in the corer barrel.
2. At the specified sampling location, force or drive the corer to the specified depth.
3. Twist and withdraw the corer in a smooth motion.
4. Retrieve the sampling device; remove the corer nosepiece (if possible) and remove the liner(s); cap the liner(s) and seal the caps with Teflon tape.
5. Wipe the outside of the liner clean with a Kimwipe or clean paper towel. Label the top and bottom ends of the liner(s).

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6. Place capped and sealed liners in individual zip-top plastic bags, and seal the bags.
7. Immediately pack all samples into a chilled cooler.

5.5.3 Method for Collecting Samples for Nonvolatile Organic and Inorganic Analysis Using a Corer (also applies to augers)

The following steps must be followed when collecting subsurface sediment/sludge samples that underlie shallow water for analytes not degraded by aeration:

1. At the specified sampling location, force or drive the corer to the specified depth.
2. Twist and withdraw the corer in a smooth motion.
3. Retrieve the sampling device. Remove the corer nosepiece (if possible) and extrude the sample into a stainless steel or Teflon-lined pan or bowl. Collect sufficient sample volume to fill all containers.
4. Use a stainless steel or Teflon spoon or spatula to homogenize and then divide the sample material into the appropriate number of sample containers.
5. Fill each container to approximately 75-90% capacity, filling containers for organics analyses first. Close the container with a Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel.
6. Place the sample container(s) in individual zip-top plastic bags, and seal the bags.
7. Immediately pack all samples into a chilled cooler.

5.6 Sediment/Sludge Sample Collection Using a Dredge from Deep Waters

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SOP 1-1

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5.6.1 Method for Collecting Samples for Volatile Organic Analysis

The following steps must be followed when collecting deep water sediment/sludge VOC samples:

1. Attach a clean piece of a 1/2- to 3/4-inch braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach the sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.
2. Attach the free end of the sampling line to a fixed support to prevent loss of the sampler.
3. At the specified sampling location, open the sampler jaws and slowly lower the sampler until contact with the bottom (sediment/sludge) is felt.
4. Release tension on the line; allow sufficient slack for the mechanism (latch) to release. Slowly raise the sampler.
5. Once the sampler is above the water surface, place the sampler in a stainless steel or Teflon-lined tray or pan. Open the sampler. Immediately collect the sample for VOC analysis, using a stainless steel or Teflon spoon or spatula. Fill each container to the top to minimize head space.
6. Once each container is filled, close the container with the Teflon-lined cap. Wipe the outside of sample containers clean with a Kimwipe or clean paper towel. Affix a sample tag with the sample information.
7. Place the sample container(s) in individual zip-top plastic bags, and seal the bags.
8. Immediately pack all samples into a chilled cooler.

5.6.2 Method for Collecting Samples for Nonvolatile Organic and Inorganic Compounds

The following steps must be followed when collecting deep water sediment/sludge samples for analytes not degraded by aeration:

1. Attach a clean piece of 1/2- to 3/4-inch braided nylon line or Teflon-coated wire rope to the top of the sampler. The line must be of sufficient length to reach sediment or sludge and have enough slack to release the mechanism. Mark the distance to the bottom on the line.

SAMPLE CUSTODY

SOP 1-2

Revision: 1

Date: June 30, 1994

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Prepared: David O. Johnson / 7-14-94 Signature/Date Technical Review: Paul Lane 7/21/94 Signature/Date
QA Review: Marguerite E. Jones 7/22/94 Signature/Date Approved: Pat Hunt 8/12/94 Signature/Date
Issued: Rosemary Elbert 8/19/94 Signature/Date

1.0 OBJECTIVE

Due to the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM Federal) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

2.0 BACKGROUND

2.1 Definitions

Sample - A material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession.
2. It is in your view, after being in your possession.
3. It was in your possession and you locked it up.
4. It is in a designated secure area.

Chain-of-Custody Record - Form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

SAMPLE CUSTODY

SOP 1-2

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Sample Label - Adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - Tag attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 RESPONSIBILITIES

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The Field Team Leader is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The Field Team Leader is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records.

4.0 REQUIRED SUPPLIES

- Chain-of-Custody Records (applicable CDM Federal forms)
- Custody seals
- Sample labels or tags
- Clear Tape

5.0 PROCEDURES

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a Chain-of-Custody Record. This procedure will be followed for all samples collected or split samples accepted.

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Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations prior to the actual fieldwork. As few people as possible should handle samples.
2. The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
3. Sample labels or tags shall be completed for each sample, using waterproof ink.
4. The Field Team Leader determines whether proper custody procedures were followed during the fieldwork and decides if additional samples are required.

Transfer of Custody and Shipment

1. Samples are accompanied by a Chain-of-Custody Record (see Figure 1 for example of Chain-of-Custody Record). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in the appropriate laboratory.
 - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the form.
 - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.
 - If samples are left unattended or a person refuses to sign, this must be documented and explained on the Chain-of-Custody Record.
2. Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate custody record accompanying each shipment.
3. All shipments will be accompanied by the Chain-of-Custody Record identifying its contents. The original record will accompany the shipment, and the copies will be retained by the Field

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Team Leader and if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the Field Team Leader as part of the permanent documentation. (Refer to Figure 1)

Procedure for Completing CDM Federal Chain-of-Custody Record (Refer to Figure 1.)

1. Record project number.
2. Record Field Team Leader for the project.
3. Record the name and address of the laboratory to which samples are being shipped.
4. Record the record number and total number of records being shipped for the day.
5. Enter the project name/location or code number.
6. Record overnight courier's airbill number.
7. Note sample type (matrix) and reference number. Include reference number on the Chain-of-Custody Record, box #9.
8. Record sample identification number.
9. Enter the reference number from box #7.
10. Enter date of sample collection.
11. Enter time of sample collection in military time.
12. Enter an X in appropriate box for sample designation - composite or grab.
13. Samplers must enter their initials next to the samples they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter MS/MSD (matrix spike/matrix spike duplicate) if sample is for laboratory quality control, or other remarks (e.g. sample depth).

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16. Record the type of the preservative added by reference number and sample pH. Use the remarks column if no space is dedicated to preservative.
17. All samplers must sign in the space provided.
18. The originator checks information entered in items 1 through 17 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).
 - Upon completion of the custody record form, the top two copies (usually white and yellow) shall be sent with the samples to the laboratory; the bottom copy (usually pink) is retained for the project files. Additional copies will be retained for the project file or distributed as required to the appropriate sample coordinators.
19. The laboratory sample custodian receiving the samples checks the sample label information against the custody record form. He or she also checks sample condition and notes anything unusual under "Remarks" on the custody record form. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the pink copy. The white copy is returned to CDM Federal.

5.2 Sample Labels and Tags

Sample labels or tags will be utilized for all samples collected or accepted for CDM Federal projects.

1. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.
2. Sample tags will be securely attached to the sample bottle. On 80 oz. amber bottles, the tag string may be looped through the ring style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted and relooped around the neck until the slack in the string is removed.
3. One label or tag will be completed for each sample container collected. Each label or tag will be completed as follows (see Figure 2 for example of sample tag); labels are completed with the equivalent information:
 - Record the Project Code (i.e., project or task number).
 - Enter the Station Number if applicable.
 - Record the date to indicate the month, day, and year of sample collection.
 - Enter the time (military) of sample collection.

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Figure 2
EXAMPLE Sample Tag

 <small>★ GPO:1992-401-217</small>		Designate:		Preservative:	
		Grab	Comp.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Time	Month/Day/Year	Station No.	Project Code	ANALYSES	
				BOD Arsenic Solids (TSS) (TDS) (SS)	
Station Location	Samplers (Signatures)		COD, TOC, Nutrients		
			Phenolics		
			Mercury		
			Metals		
			Cyanide		
			Oil and Grease		
			Organics GC/MS		
			Priority Pollutants		
			Volatile Organics		
			Pesticides		
Mutagenicity					
Bacteriology					
Remarks:					
Tag No.		Lab Sample No.			
30101					

NOTE: Equivalent sample labels or tags may be used.

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- Place a check to indicate composite or grab sample.
- Record the sample location.
- Samplers must sign in the space provided.
- Place a check next to "yes" or "no" to indicate if a preservative was added.
- Under "analyses," place a check next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number."
- Under "remarks," add additional, relevant information.

5.3 Custody Seals

Custody seals must be placed on the shipping containers prior to shipment. The seal should be signed and dated by a field team member.

Custody seals may also be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

CDM Federal's Standard Operating Procedure 2-5: Packaging and Shipping of Environmental Samples establishes a uniform method for packaging and shipping low-level environmental samples.

6.0 RESTRICTIONS/LIMITATIONS

For EPA Contract Laboratory Program (CLP) sampling events, combined chain-of-custody/traffic report forms or other EPA-specific records may be utilized. Refer to regional guidelines for completing these forms.

7.0 REFERENCES

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.

U.S. Environmental Protection Agency, *Samplers Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

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Date: February 18, 1999

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Prepared: Del R. Baird

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QA Review: David O. Johnson

Approved:  2/24/99

Signature/Date

Issued: Rosemary Gustin 2/24/99
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for collecting surface soil samples.

2.0 BACKGROUND

2.1 Definitions

Surface Soil - The soil that exists down from the surface approximately one foot (30 centimeters). Depending on application, the soil interval to be sampled will vary.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

Composite - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, then a single average sample is taken from the mixture.

Spoon/Scoop - A small stainless steel or Teflon utensil approximately 6 inches in length with a stem-like handle.

Trowel - A small stainless steel or Teflon shovel approximately 6 to 8 inches in length with a slight (approximately 140°) curve across. The trowel has a stem-like handle (for hand operation). Samples are collected with a spooning action.

2.2 Discussion

Surface soil samples are collected to determine the type(s) and level(s) of contamination and are often important to risk assessment. These samples may be collected as part of an investigative plan, site-

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specific sampling plan, and/or as a screen for "hot spots," which may require more extensive sampling. Sediment(s) and sludge(s) that have been exposed by evaporation, stream rerouting, or any other means are collected by the same methods as those for surface soil(s). Typically, the top 1 to 2 centimeters (cm) of material, including vegetation, are carefully removed before collection of the sample.

Surface soil and exposed sediment or sludge are collected using stainless steel and/or Teflon-lined trowels or scoops.

2.3 Associated Procedures

- CDM Federal SOP 1-2, Sample Custody
- CDM Federal SOP 2-5, Packaging and Shipping of Environmental Samples
- CDM Federal SOP 4-1, Field Logbook Content and Control
- CDM Federal SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling.

Field Team Leader - The Field Team Leader is responsible for ensuring that field personnel collect surface soil samples in accordance with this and other relevant procedures.

4.0 REQUIRED EQUIPMENT

- Insulated cooler and waterproof sealing tape
- Ice bags or "blue ice"
- Latex or appropriate gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Stainless steel and/or Teflon-lined spatulas and pans, trays, or bowls
- Stainless steel and/or Teflon-lined trowels or spoons (or equipment as specified in the site-specific plans)

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- Plastic sheeting

Additional equipment are discussed in Section 5.2.2, VOC Field Sampling/Preservation Methods.

5.0 PROCEDURES

5.1 Preparation

The following steps must be followed when preparing for sample collection:

1. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.
2. The collection points shall be stated, located on a site map, and referenced in the field logbook.
3. Processes for verifying depth of sampling must be specified in the site-specific plans.
4. Place clean plastic sheeting on a flat, level surface near the sampling area, if possible, and place equipment to be used on the plastic; place the insulated cooler(s) on separate plastic sheeting. Cover all equipment and supplies with clean plastic sheeting when not in use.
5. A clean, decontaminated trowel, scoop, or spoon will be used for each sample collected. Other equipment may be used (e.g., shovels) if constructed of stainless steel.

5.2 Collection

The following general steps must be followed when collecting surface soil samples:

1. Surface soil samples are normally collected from the least-contaminated to the most-contaminated areas. Stay outside a specific sampling location until all samples are collected at that location.
2. Document the sampling events, recording the information in the designated field logbook. Document any and all deviations from SOPs in the field logbook and include rationale for changes. See CDM Federal SOP 4-1.

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3. Carefully remove stones, vegetation, snow, etc. from the sampling location surface.
4. First collect sample portions or aliquots for volatile analyses as well as any other samples that would be degraded by aeration. Follow with collection of samples for other analyses.
6. Decontaminate sampling equipment between locations. See CDM Federal SOP 4-5.

5.2.1 Method for Collecting Samples for Volatile Organic Compound (VOC) Analysis

The requirements for collecting grab samples of surface soil for VOCs or other samples degraded by aeration are as follows:

1. VOC samples shall be collected with the least disturbance possible.
2. VOC samples shall be collected as grab samples; however, the method of collection will vary from site to site, based on data quality objectives and the degree of known or suspected contamination.
3. Label the sample containers with the appropriate information. Secure the label, covering it with a piece of clear tape.
4. Use a clean stainless steel or Teflon-lined trowel or spoon (or tube) to collect sufficient material in one grab, over the required sampling interval, to fill the sample containers.
5. With the aid of a clean stainless steel spatula, quickly fill the sample containers directly from the sampling device, removing stones, twigs, grass, etc., from the sample. Fill the containers as full and compact as possible to minimize headspace.
6. Immediately secure the Teflon-lined caps on the sample container.
7. Wipe the containers clean with a clean Kimwipe or paper towel.
8. Place the containers in individual zip-top plastic bag(s) and seal the bag(s).
9. Pack all samples as required. Include properly completed documentation, and affix signed and dated custody seals to the cooler lid.

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5.2.2 Field Sampling/Preservation Methods

The following four sections contain SW 846 methods for sampling and field preservation. These methods include EN CORE™ Sampler Method for low level detection limits, EN CORE™ Sampler Method for high level/detection limits/screening, Acid preservation, and Methanol preservation. These methods may be used if required by the EPA Region, client, or governing sample plan. These methods are very detailed and contain equipment requirements at the beginning of each section.

Note: Some variations from these methods may be required depending on the contracted analytical laboratory, such as sample volume.

5.2.2.1 EN CORE™SAMPLER COLLECTION FOR LOW LEVEL ANALYSES (≥ 1 UG/KG)

EN CORE™Sampling Equipment Requirements

The following equipment is required for low level analysis:

- Two 5g samplers.
- One 25g sampler or one 5g sampler for screening and or high level analysis. (The sampler size used will be dependent on who is doing the sampling and who is doing the laboratory analysis).
- One dry weight cup.
- One T-handle.
- Paper toweling.

EN CORE™ Sampling Steps for Low Level Analysis

1. Remove sampler and cap from package and attach T-handle to sampler body.
2. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
3. Use paper toweling to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.
5. Fill out label and attach to sampler.
6. Repeat procedure for the other two samplers.

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7. Collect dry weight sample.
8. Store samplers at 4 degrees Celsius.

Ship sample containers with plenty of ice to the laboratory within 40 hours of collection.

5.2.2.2 ACID PRESERVATION SAMPLING FOR LOW LEVEL ANALYSES (≥ 1 UG/KG)

Acid Preservation Sampling Equipment Requirements

The following equipment and supplies are required for field Acid preservation:

- One 40mL VOA vial with acid preservation (for field testing of soil pH). Two pre-weighed 40mL VOA vials with acid preservative and stir bar (for lab analysis)
- Two pre-weighed 40mL VOA vials with water and stir bar (in case samples effervesces).
- One pre-weighed jar that contains methanol or a pre-weighed empty jar accompanied with a pre-weighed vial that contains methanol (for screening sample and/or high level analysis).
- One dry weight cup.
- One 2oz jar with acid preservative (in case additional acid is needed due to high soil pH).
- One scoop capable to deliver about one gram of solid sodium bisulfate.
- pH paper.
- Weighing balance that weighs to 0.01 g (with an accuracy of ± 0.1 g).
- Set of balance weights used in daily balance calibration.
- Gloves for working with pre-weighed sample vials.
- Paper toweling.
- Sodium bisulfate acid (NaHSO_4) acid.
- A cutoff plastic syringe or other coring device to deliver 5 g or 25g of soil.

Testing Effervescing Capacity of Soils

Soils must be tested with acid to determine the amount of effervescing that will occur when preserved with acid. Effervescing will drive off VOCs as well as create a very high pressure in a sealed vial which could explode. The following steps will provide information on the effervescing capacity of the soil.

1. Place ~5g of soil into a vial that contains acid preservative and no stir bar.
2. Do not cap this vial as it may EXPLODE upon interaction with the soil.

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3. Observe the sample for gas evolution (due to carbonates in the soil).
4. If vigorous or sustained gas evolution occurs; then acid preservation is not acceptable to preserve the sample.
 - In this case the samples need to be collected in the VOA vials with only water and a stir bar. The vials with acid preservative CANNOT be used.
5. If a small amount or no gas evolution occurs: then acid preservation is acceptable to preserve the sample. Keep this testing vial for use in the buffering testing detailed below.
 - In this case the samples need to be collected in the VOA vials with the acid preservative and a stir bar.

Testing Buffering Capacity of Soils

The soils must be tested to determine the quantity of acid that is required to reach a less than 2 pH reading. The following steps will assist in determining this quantity.

1. If acid preservation is acceptable for sampling soils then the sample vial that was used in the effervescing testing can be used here for the buffering testing.
2. Cap the vial that contains 5g of soil, acid preservative and no stir bar from step 1 in the effervescing testing.
3. Shake the vial gently to attempt to make a homogenous solution.
4. When done, open the vial and check the pH of the acid solution with the pH paper.
 - If the pH paper reads below 2 then the sampling can be done in the two pre-weighed 40mL VOA trials with the acid preservative and stir bar. Since the pH was below 2, it is not necessary to add additional acid to the vials.
 - If the pH paper reads above 2, then additional acid needs to be added to the sample vial.
5. Use the jar with the solid sodium bisulfate acid and add another one gram of acid to the sample.

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6. Cap the vial and shake thoroughly again.
7. When done, open the vial and check the pH of the acid solution with a new piece of paper.
 - If the pH paper reads below 2 then the sampling can be done in the two pre-weighed 40mL VOA trials with the acid preservative and stir bar and one extra gram of acid.
 - Make a note of the extra gram of acid needed so the same amount of extra acid can be added to the vials the lab will analyze.
 - If the pH paper reads above 2, then add another gram of acid and repeat this procedure one more time.

Now that the soil chemistry has been determined the actual sampling can occur. The procedure stated below assumes the correct vials are used based on the guidance discussed.

Sample Preservation Steps

1. Wear gloves during all handling of pre-weighed vials.
2. Quickly collect a 5g sample using a cut off plastic syringe or other coring device designed to deliver 5g of soil from a freshly exposed surface of soil.
3. Carefully wipe exterior of sample collection device with clean paper toweling.
4. Quickly transfer to the appropriate VOA trial, extruding with caution so that the solution does not splash out of the vial.
5. Add more acid if necessary (this is based on the buffering testing discussed in the previous section).
6. Use the paper toweling and quickly remove any soil off the vial threads.
7. Cap vial and weigh the jar to the nearest 0.01 g.
8. Record exact weight on sample label.
9. Repeat sampling procedure for the duplicate VOA vial.

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10. Weigh the vial with methanol preservative in it to the nearest 0.01g. If the weight of the vial with methanol varies by more than 0.01g from the original weight recorded on the vial-discard the vial. If the weight is within tolerance it can be used for soil preservation below.
11. Take the empty jar or the jar that contains the methanol preservative.
12. Quickly collect a 25g or 5g sample using a cut off plastic syringe or other coring device designed to deliver 25g or 5g of soil from a freshly exposed surface of soil. The 25g or 5g size is dependent on who is doing the sampling and who is doing the laboratory analysis.
13. Carefully wipe the exterior of the collection device with clean paper toweling.
14. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol be careful not to splash the methanol outside of the vial. Again, the type of jar received is dependent on who is doing the laboratory analysis.
15. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided-using only one vial of methanol preservative per sample jar.
16. Use the paper toweling and remove any soil off of the vial threads and cap the jar.
17. Weigh the jar with the soil in it to the nearest 0.01g and record the weight on the sample label.
18. Collect dry weight sample-fill container.
19. Store samples at 4 degrees Celsius.
20. Ship sample containers with plenty of ice and per Department of Transportation (DOT) regulations (CORROSIVE. FLAMMABLE LIQUID. POISON) to the laboratory.

5.2.2.3 EN CORE SAMPLER COLLECTION FOR HIGH LEVEL ANALYSES (≥ 200 UG/KG)

EN CORE™ Sampling Equipment Requirements

The following equipment is required for high level analysis:

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- One 25g sampler or one 5g sampler (The sampler size used will be dependent on who is doing the sampling and who is doing the laboratory analysis).
- One dry weight cup.
- One T-handle.
- Paper toweling.

EN CORE™ Sampling Steps for High Level Analysis

1. Remove sample and cap from package and attach T-handle to sampler body.
2. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
3. Use paper toweling to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.
5. Fill out label and attached to sampler.
6. Collect dry weight sample.
7. Store samplers at 4 degrees Celsius.
8. Ship sample containers with plenty of ice to the laboratory within 40 hours of collection.

5.2.2.4 METHANOL PRESERVATION SAMPLING FOR HIGH LEVEL ANALYSES (≥200 UG/KG)

Methanol Preservation Sampling Equipment Requirements

- One pre-weighed jar that contains methanol or a pre-weighed empty jar accompanied with a pre-weighed vial that contains methanol (laboratory grade).
- One dry weight cup.
- Weighing balance that accurately weighs to 0.01g (with accuracy of ± 0.1 g).
- Set of balance weights used in daily balance calibration.
- Latex gloves.
- Paper towel.

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- Cutoff plastic syringe or other coring device to deliver 5g or 25g of soil.

Sampling Preservation Steps

1. Wear gloves during all handling of pre-weighed vials.
2. Weigh the vial with methanol preservative in it to the nearest 0.01g. If the weight of the vial with methanol varies by more than 0.01g from the original weight recorded on the vial- discard the vial. If the weight is within tolerance it can be used for soil preservation/collection below.
3. Take the empty jar or the jar that contains the methanol preservative.
4. Quickly collect a 25g or 5g sample using a cut off plastic syringe or other coring device designed to deliver 25g or 5g of soil from a freshly exposed surface of soil. The 25g or 5g size used is dependent on who is doing the sampling and who is doing the laboratory analysis.
5. Carefully wipe the exterior of the collection device with clean paper toweling.
6. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol be careful not to splash the methanol outside of the vial. Again, the type of jar used is dependent on who is doing the laboratory analysis.
7. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided-using only one vial of methanol preservative per sample jar.
8. Using the paper toweling-remove any soil off of the vial threads and cap the jar.
9. Weigh the jar with the soil in it to the nearest 0.01g and record the weight on the sample label.
10. Collect dry weight sample-fill container.
11. Store samples at 4 degrees Celsius.
12. Ship sample containers with plenty of ice and per DOT regulations (CORROSIVE. FLAMMABLE LIQUID. POISON) to the laboratory.

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5.2.3 Method for Collecting Samples for Nonvolatile Organic or Inorganic Compound Analysis

The requirements for collecting samples of surface soil for nonvolatile organic or inorganic analyses are as follows:

1. Label each sample container with the appropriate information. Secure the label by covering it with a piece of clear tape.
2. Use a decontaminated stainless steel or Teflon-lined trowel or spoon to obtain sufficient sample from the required interval and subsampling points, if necessary, to fill the specified sample containers.
3. Empty the contents of each fill of the sampling device directly into a clean stainless steel or Teflon-lined tray or bowl.
4. Homogenize the sample by mixing with a spoon, spatula, or trowel.
5. Use the spoon, spatula, or trowel to distribute the uniform mixture into the labeled sample containers. Fill organic sample containers first, then inorganics.
6. Secure the appropriate cap on each container immediately after filling it.
7. Wipe the sample containers clean with a clean Kimwipe or paper towel.
8. Place sample containers in individual zip-top plastic bags and seal the bags.
9. Pack all samples as required. Include properly completed documentation, and affix custody seals to the cooler lid.
10. Decontaminate sampling equipment according to CDM Federal SOP 4-5.

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6.0 RESTRICTIONS/LIMITATIONS

When grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, it is necessary to minimize sample disturbance and, hence, analyze loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

7.0 REFERENCES

U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Quality Control Requirements For Field Methods*, DOE/HWP-69/R1, July 1990 or current revision.

U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Standard Operating Procedures For Site Characterizations*, DOE/HWP-100, July 1990 or current revision.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987 or current revision.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, November 1986, (as amended by Update III, June 1997). Method 5035: Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and requirements for collecting soil samples from the unconsolidated zone. Techniques include use of hand augers, Shelby tubes, and split-spoon samplers.

2.0 BACKGROUND

2.1 Definitions

Unconsolidated Zone - The layer of soil above bedrock that exists in a relatively loose state.

Hand Auger - A stainless steel cylinder (bucket) approximately 3 to 4 inches in diameter and one foot in length, open at both ends with the bottom edge designed to twist into the soil and cut out a soil core. The bucket collects the soil sample. The auger has a T-shaped handle (for hand operation) attached to the top of the bucket by extendable stainless steel rod(s).

Shelby Tube - A cylindrical sampling device, generally made of steel, which is driven into the subsurface soil through the hollow-stem auger. The tube, once retrieved, may be capped and the undisturbed soil sample extruded in the laboratory prior to analysis.

Split-Spoon - A cylindrical sampling device, generally made of carbon steel, which fits into a hollow stem auger. The spoon is hinged lengthwise, which allows the sample to be retrieved by opening ("splitting") the spoon.

Subsurface Soil - The soil which exists deeper than approximately one foot (30 centimeters) from the surface, but above bedrock or any other consolidated material.

Grab Sample - A discrete portion or aliquot taken from a specific location at a given point in time.

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Liner - A cylindrical sampling device, generally made of brass, stainless steel, or Teflon, that is placed inside a split-spoon or hand auger bucket to collect undisturbed samples.

Composite Sample - Two or more subsamples taken from a specific media and site at a specific point in time. The subsamples are collected and mixed, then a single average sample is taken from the mixture.

Auger Flight - A steel section length attached to an auger to extend the auger as coring depth increases.

2.2 Discussion

Shallow subsurface soil samples (to depths between 6 inches and 10 feet) may be collected using hand augers. However, soil samples collected with a hand auger are commonly of poorer quality than those collected by split-spoon or Shelby tube samplers since the soil sample is disturbed in the augering process. Split-spoon and Shelby tube liners may be used to prevent loss of volatile organic compounds (VOCs). The size and construction material of sampling devices should be selected based on project and analytical objectives and defined in site-specific plans.

2.3 Associated Procedures

- CDM Federal SOP 1-2, Sample Custody
- CDM Federal SOP 2-5, Packaging and Shipping of Environmental Samples
- CDM Federal SOP 3-5, Lithologic Logging
- CDM Federal SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and the required equipment, and for ensuring that subsurface soil samples are collected in accordance with this procedure and any other SOPs pertaining to specific media sampling.

Field Team Leader - The Field Team Leader is responsible for ensuring that field personnel collect subsurface soil samples in accordance with this SOP and other relevant procedures.

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4.0 REQUIRED EQUIPMENT

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens and markers
- Labels and appropriate forms/documentation for sample shipment
- Clear, waterproof tape
- Appropriate sample containers
- Insulated cooler(s) and waterproof sealing tape
- Ice bags or "blue ice"
- Latex or appropriate gloves
- Plastic zip-top bags
- Personal protective clothing and equipment
- Stainless steel and/or Teflon-lined spatulas and pans, trays, or bowls
- Plastic sheeting

Additional equipment is discussed in Section 5.2.2 VOC Field Sampling/Preservation Methods.

4.2 Manual (Hand) Augering

- Hand auger: flighted-, bucket-, or tube-type auger as required by the site-specific plans
- Extension rods, as needed
- Wrench(es), pliers

4.3 Split-Spoon and Shelby Tube Sampling

- Drill rig equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site-specific plans
- Sufficient numbers of split-spoon or Shelby tube samplers so that at least one is always decontaminated and available for sampling. Three split-spoon or Shelby tube samplers are generally the minimum necessary. (Shelby tubes are usually used only once.)
- Split-spoon liners, as appropriate
- Wrench(es), hammer

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5.0 PROCEDURES

5.1 Preparation

1. Don the appropriate personal protective clothing as dictated by the site-specific health and safety plan.
2. The collection points shall be stated, located on a site map, and referenced in the field logbook.
3. Processes for verifying depth of sampling must be specified in the site-specific plans.
4. Clear away vegetation and debris from the surface at the boring location.
5. Prepare an area next to the sample collection location for laying out cuttings by placing plastic sheeting on the ground or over a work area.
6. Set up a decontamination line, if decontamination is required. See CDM Federal SOP 4-5.

5.2 Collection

The following general steps must be followed when collecting all subsurface soil samples:

1. VOC samples or samples degraded by aeration shall be collected first and with the least disturbance possible. These samples shall be collected as grab samples.
2. Sampling information shall be recorded in the field logbook and on any associated forms. Describe lithology, according to CDM Federal SOP 3-5, in the field logbook or on the Lithologic Log Form.
3. Specific sampling devices to be used shall be identified in the site-specific plans and recorded in the field logbook.
4. Care must be taken to prevent cross-contamination and misidentification of samples.
5. Processes for verifying depth of sampling must be specified in the site-specific plans.
6. Sample bottles for VOC analysis should be filled completely to minimize headspace.

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5.2.1 Manual (Hand) Augering

The following steps must be followed when collecting hand-augered samples:

1. Auger to the depth required for sampling. Place cuttings on plastic sheeting or as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.
2. Throughout the augering, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.
3. Cease augering when the top of the specified sampling depth has been reached. If required, remove the auger from the hole and decontaminate the auger or use a fresh auger. Then obtain the sample.
4. Collect a grab sample for VOC analyses (or samples that may be degraded by aeration) immediately and place in sample container. Sample bottles should be filled completely to minimize headspace.
5. Label the sample container with the appropriate information. Secure the label, covering it with a piece of clear tape.
6. Remaining sample should be homogenized for other analyses prior to placing samples in the appropriate containers. Label containers as required.
7. Wipe containers clean with a clean Kimwipe or paper towel.
8. Place the containers in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.
9. Proceed with further sampling, as required by the site-specific plans.
10. When all sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.
11. Complete the field logbook entry and other appropriate forms, being sure to record all relevant information before leaving the site.
12. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-5 or site-specific plans.

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5.2.2 Field Sampling/Preservation Methods

The following four sections contain SW 846 Methods for sampling and field preservation. These methods include ENCORE™ Sampler Method for low level detection limits, ENCORE™ Sampler Method for high level limits/screening, Acid preservation, and Methanol preservation. These methods may be used if required by the EPA Region, client, or governing sample plan. These methods are very detailed and contain equipment requirements at the beginning of each section.

Note: Some variations from these methods may be required depending on the contracted analytical laboratory, such as sample volume.

5.2.2.1 EN CORE™SAMPLER COLLECTION FOR LOW LEVEL ANALYSES (≥1 UG/KG)

EN CORE™Sampling Equipment Requirements

The following equipment is required for low level analysis:

- Two 5g samplers.
- One 25g sampler or one 5g sampler for screening and or high level analysis. (The sampler size used will be dependent on who is doing the sampling and who is doing the laboratory analysis).
- One dry weight cup.
- One T-handle.
- Paper toweling.

EN CORE™ Sampling Steps for Low Level Analysis

1. Remove sampler and cap from package and attach T-handle to sampler body.
2. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
3. Use paper toweling to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.
5. Fill out label and attach to sampler.

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6. Repeat procedure for the other two samplers.
7. Collect dry weight sample.
8. Store samplers at 4 degrees Celsius.

Ship sample containers with plenty of ice to the laboratory within 40 hours of collection.

5.2.2.2 ACID PRESERVATION SAMPLING FOR LOW LEVEL ANALYSES (≥ 1 UG/KG)

Acid Preservation Sampling Equipment Requirements

The following equipment and supplies are required for field Acid preservation:

- One 40mL VOA vial with acid preservation (for field testing of soil pH). Two pre-weighed 40mL VOA vials with acid preservative and stir bar (for lab analysis)
- Two pre-weighed 40mL VOA vials with water and stir bar (in case sample effervesces).
- One pre-weighed jar that contains methanol or a pre-weighed empty jar accompanied with a pre-weighed vial that contains methanol (for screening sample and/or high level analysis).
- One dry weight cup.
- One 2oz jar with acid preservative (in case additional acid is needed due to high soil pH).
- One scoop capable to deliver about one gram of solid sodium bisulfate.
- pH paper.
- Weighing balance that weighs to 0.01 g (with an accuracy ± 0.1 g).
- Set of balance weights used in daily balance calibration.
- Gloves for working with pre-weighed sample vials.
- Paper toweling.
- Sodium bisulfate acid (NaHSO_4) acid.
- A cutoff plastic syringe or other coring device to deliver 5 g or 25g of soil.

Testing Effervescing Capacity of Soils

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Soils must be tested with acid to determine the amount of effervescing that will occur when preserved with acid. Effervescing will drive off VOCs as well as create a very high pressure in a sealed vial which could explode. The following steps will provide information on the effervescing capacity of the soil.

1. Place ~5g of soil into a vial that contains acid preservative and no stir bar.
2. Do not cap this vial as it may EXPLODE upon interaction with the soil.
3. Observe the sample for gas evolution (due to carbonates in the soil).
4. If vigorous or sustained gas evolution occurs; then acid preservation is not acceptable to preserve the sample.
 - In this case the samples need to be collected in the VOA vials with only water and a stir bar. The vials with acid preservative CANNOT be used.
5. If a small amount or no gas evolution occurs; then acid preservation is acceptable to preserve the sample. Keep this testing vial for use in the buffering testing detailed below.
 - In this case the samples need to be collected in the VOA vials with the acid preservative and a stir bar.

Testing Buffering Capacity of Soils

The soils must be tested to determine the quantity of acid that is required to reach a less than 2 pH reading. The following steps will assist in determining this quantity.

1. If acid preservation is acceptable for sampling soils then the sample vial that was used in the effervescing testing can be used here for the buffering testing.
2. Cap the vial that contains ~5g of soil, acid preservative and no stir bar from step 1 in the effervescing testing.
3. Shake the vial gently to attempt to make a homogenous solution.
4. When done, open the vial and check the pH of the acid solution with the pH paper.

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- If the pH paper reads below 2 then the sampling can be done in the two pre-weighed 40mL VOA trials with the acid preservative and stir bar. Since the pH was below 2, it is not necessary to add additional acid to the vials.
- If the pH paper reads above 2, then additional acid needs to be added to the sample vial.
- 5. Use the jar with the solid sodium bisulfate acid and add another one gram of acid to the sample.
- 6. Cap the vial and shake thoroughly again.
- 7. When done, open the vial and check the pH of the acid solution with a new piece of paper.
- If the pH paper reads below 2 then the sampling can be done in the two pre-weighed 40mL VOA trials with the acid preservative and stir bar and one extra gram of acid.
- Make a note of the extra gram of acid needed so the same amount of extra acid can be added to the vials the lab will analyze.
- If the pH paper reads above 2, then add another gram of acid and repeat this procedure one more time.

Now that the soil chemistry has been determined the actual sampling can occur. The procedure stated below assumes the correct vials are used based on the guidance discussed.

Sample Preservation Steps

1. Wear gloves during all handling of pre-weighed vials.
2. Quickly collect a 5g sample using a cut off plastic syringe or other coring device designed to deliver 5g of soil from a freshly exposed surface of soil.
3. Carefully wipe exterior of sample collection device with clean paper toweling.
4. Quickly transfer to the appropriate VOA trial, extruding with caution so that the solution does not splash out of the vial.

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5. Add more acid if necessary (this is based on the buffering testing discussed in the previous section).
6. Use the paper toweling and quickly remove any soil off the vial threads.
7. Cap vial and weigh the jar to the nearest 0.01 g.
8. Record exact weight on sample label.
9. Repeat sampling procedure for the duplicate VOA vial.
10. Weigh the vial with methanol preservative in it to the nearest 0.01g. If the weight of the vial with methanol varies by more than 0.01g from the original weight recorded on the vial-discard the vial. If the weight is within tolerance it can be used for soil preservation below.
11. Take the empty jar or the jar that contains the methanol preservative.
12. Quickly collect a 25g or 5g sample using a cut off plastic syringe or other coring device designed to deliver 25g or 5g of soil from a freshly exposed surface of soil. The 25g or 5g size is dependent on who is doing the sampling and who is doing the laboratory analysis.
13. Carefully wipe the exterior of the collection device with clean paper toweling.
14. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol be careful not to splash the methanol outside of the vial. Again, the type of jar received is dependent on who is doing the laboratory analysis.
15. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided-using only one vial of methanol preservative per sample jar.
16. Use the paper toweling and remove any soil off of the vial threads and cap the jar.
17. Weigh the jar with the soil in it to the nearest 0.01g and record the weight on the sample label.
18. Collect dry weight sample-fill container.
19. Store samples at 4 degrees Celsius.

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20. Ship sample containers with plenty of ice and per Department of Transportation (DOT) regulations (CORROSIVE, FLAMMABLE LIQUID, POISON) to the laboratory.

5.2.2.3 EN CORE™ SAMPLER COLLECTION FOR HIGH LEVEL ANALYSES (≥200 UG/KG)

EN CORE™ Sampling Equipment Requirements

The following equipment is required for high level analysis:

- One 25g sampler or one 5g sampler (The sampler size used will be dependent on who is doing the sampling and who is doing the laboratory analysis).
- One dry weight cup.
- One T-handle.
- Paper toweling.

EN CORE™ Sampling Steps for High Level Analysis

1. Remove sample and cap from package and attach T-handle to sampler body.
2. Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
3. Use paper toweling to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.
5. Fill out label and attached to sampler.
6. Collect dry weight sample.
7. Store samplers at 4 degrees Celsius.
8. Ship sample containers with plenty of ice to the laboratory within 40 hours of collection.

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5.2.2.4 METHANOL PRESERVATION SAMPLING FOR HIGH LEVEL ANALYSES (≥ 200 UG/KG)

Methanol Preservation Sampling Equipment Requirements

- One pre-weighed jar that contains methanol or a pre-weighed empty jar accompanied with a pre-weighed vial that contains methanol (laboratory grade).
- One dry weight cup.
- Weighing balance that accurately weighs to 0.01g (with accuracy of ± 0.1 g).
- Set of balance weights used in daily balance calibration.
- Latex gloves.
- Paper towel.
- Cutoff plastic syringe or other coring device to deliver 5g or 25g of soil.

Sampling Preservation Steps

1. Wear gloves during all handling of pre-weighed vials.
2. Weigh the vial with methanol preservative in it to the nearest 0.01g. If the weight of the vial with methanol varies by more than 0.01g from the original weight recorded on the vial-discard the vial. If the weight is within tolerance it can be used for soil preservation/collection below.
3. Take the empty jar or the jar that contains the methanol preservative.
4. Quickly collect a 25g or 5g sample using a cut off plastic syringe or other coring device designed to deliver 25g or 5g of soil from a freshly exposed surface of soil. The 25g or 5g size used is dependent on who is doing the sampling and who is doing the laboratory analysis.
5. Carefully wipe the exterior of the collection device with clean paper toweling.
6. Quickly transfer the soil to an empty jar or a jar that contains methanol. If extruding into a jar that contains methanol be careful not to splash the methanol outside of the vial. Again, the type of jar used is dependent on who is doing the laboratory analysis.
7. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided-using only one vial of methanol preservative per sample jar.

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8. Using the paper toweling-remove any soil off of the vial threads and cap the jar.
9. Weigh the jar with the soil in it to the nearest 0.01g and record the weight on the sample label.
10. Collect dry weight sample-fill container.
11. Store samples at 4 degrees Celsius.
12. Ship sample containers with plenty of ice and per DOT regulations (CORROSIVE. FLAMMABLE LIQUID. POISON) to the laboratory.

5.2.3 Method for Collecting Samples for Nonvolatile Organic or Inorganic Compound Analysis

The requirements for collecting samples of surface soil for nonvolatile organic or inorganic analyses are as follows:

1. Label each sample container with the appropriate information. Secure the label by covering it with a piece of clear tape.
2. Use a decontaminated stainless steel or Teflon-lined trowel or spoon to obtain sufficient sample from the required interval and subsampling points, if necessary, to fill the specified sample containers.
3. Empty the contents of each fill of the sampling device directly into a clean stainless steel or Teflon-lined tray or bowl.
4. Homogenize the sample by mixing with a spoon, spatula, or trowel.
5. Use the spoon, spatula, or trowel to distribute the uniform mixture into the labeled sample containers. Fill organic sample containers first, then inorganics.
6. Secure the appropriate cap on each container immediately after filling it.
7. Wipe the sample containers clean with a clean Kimwipe or paper towel.
8. Place sample containers in individual zip-top plastic bags and seal the bags.

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9. Pack all samples as required. Include properly completed documentation, and affix custody seals to the cooler lid.
10. Decontaminate sampling equipment according to CDM Federal SOP 4-5.

5.2.4 Manual (Hand) Augering Using a Tube Sampler With Liner

The following steps must be followed when collecting hand-augered samples using a tube sampler with liner:

1. Auger to the depth required for sampling. Place cuttings on the plastic sheeting as specified in the site-specific plans. If possible, lay out the cuttings in stratigraphic order.
2. Throughout augering, make detailed notes concerning the geologic features of the soil or sediments in the field logbook.
3. Cease augering when the top of the specified sampling depth has been reached. Remove the auger from the hole and decontaminate.
4. Prepare a decontaminated tube sampler by installing a decontaminated liner in the auger tube.
5. Obtain the sample and retrieve the auger. Remove the liner from the tube and immediately cover ends with Teflon tape and cap the ends of the tube. Seal the caps with waterproof tape.
6. Label the sealed liners as required in the site-specific plans. Mark the top and bottom of the sample on the outside of the liner. Indicate boring/well number and depth on outside of liner.
7. Wipe sealed liners clean with a clean Kimwipe or paper towel.
8. Place sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.
9. Proceed with further sampling, as required by the site-specific plans.
10. When sampling is complete, dispose of cuttings, plastic sheeting, etc., as specified in the site specific plans.

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11. Decontaminate all equipment according to CDM Federal SOP 4-5.
12. Complete the field logbook entry and other forms, being sure to record all relevant information before leaving the site.
13. Properly package all samples for shipment and complete all necessary sample shipment documentation. Remand custody of samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-5 or site-specific plans.

5.2.5 Split-Spoon Sampling

The following steps must be followed when collecting split-spoon samples:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.
2. The drilling rig will be decontaminated at a separate location prior to drilling, per CDM Federal SOP 4-5 or the site-specific decontamination procedures.
3. Attach to the drill rig the hollow-stem auger with the cutting head, plug and center rod(s).
4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.
5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.
6. Remove the plug and center rods.
7. Install a decontaminated split spoon on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.
8. Mark the center rod in 6-inch increments from the top of the auger flight(s).
9. Drive the spoon using the hammer. Use a full 30-inch drop as specified by the American Society for Testing and Materials (ASTM) Method D-1586. Record the number of blows required to drive the spoon or tube through each 6-inch increment.

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10. Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little (<1 inch) or no progress is made for 50 blows of the hammer.
11. Pull the spoon or tube free by using upswings of the hammer to loosen the sampler. Pull out the center rod and spoon or tube.
12. Unscrew the split-spoon assembly from the center rod and place it on the plastic sheeting.
13. Remove the drive shoe and head assembly. If necessary, tap the split-spoon assembly with a hammer to loosen threaded couplings.
14. With the drive shoe and head assembly off, open (split) the spoon, being careful not to disturb the sample.
15. Label sample containers with appropriate information. Secure the label, covering it with a piece of clear tape.
16. If VOC analyses are to be conducted on the soil sample, place that sample in its sample container immediately after opening the spoon, filling the sample bottle completely. Seal the container immediately, then describe it in the field logbook and/or associated forms. Record the sample identification number, depth from which the sample was taken, and the analyses to be performed on the samples in the field logbook and on the appropriate forms.
17. Remaining sample should be homogenized prior to placing samples in appropriate containers. Label containers as required.
18. Wipe containers clean with a clean Kimwipe or paper towel.
19. Place containers in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.
20. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.
21. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.
22. Dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans. Backfill bore hole as specified in project-specific plans.

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23. Decontaminate split spoons and other small sampling equipment according to CDM Federal SOP 4-5 before proceeding to other sampling locations.
24. Complete the field logbook entry and other forms, being sure to record all relevant information before leaving the site.
25. Properly package all samples for shipment to laboratories and complete all necessary sample shipment documentation. Remand custody of the samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-5 or site-specific plans.

5.2.6 Split-Spoon Sampling Using Liners

The following steps must be followed when collecting samples with lined split spoons:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.
2. The drilling rig will be decontaminated at a separate location prior to drilling.
3. Attach the hollow-stem auger with the cutting head and center rod(s).
4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.
5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.
6. Remove the plug and center rods.
7. Install decontaminated liners in the split-spoon barrel.
8. Install a decontaminated split spoon on the center rod(s) and insert it into the hollow-stem auger. Connect the hammer assembly and lightly tap the rods to seat the drive shoe at the top of undisturbed soil or sediment.
9. Mark the center rod in 6-inch increments from the top of the auger flight(s).
10. Drive the spoon using the hammer. Use a full 30-inch drop as specified by ASTM Method D-1586. Record the number of blows required to drive the spoon or tube through each 6-inch increment.

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11. Cease driving when the full length of the spoon has been driven or upon refusal. Refusal occurs when little (<1 inch) or no progress is made after 50 blows of the hammer.
12. Pull the spoon or tube free by using upswings of the hammer to loosen the sampler. Pull out the center rod and spoon or tube.
13. Unscrew the split-spoon assembly from the center rod and place it on the plastic sheeting.
14. Remove the drive shoe and head assembly. If necessary, tap the split-spoon assembly with a hammer to loosen threaded couplings.
15. With the drive shoe and head assembly off, open (split) the spoon and remove the liners without disturbing the sample.
16. Immediately install Teflon tape over the ends of the liners, cap the liners, and seal the caps over the ends of the liner with waterproof tape. Label the samples as required by the site-specific plans. Mark the top and bottom of each sample on the outside of each liner. Indicate boring/well number and depth on outside of liner.
17. Wipe sealed liners clean with a clean Kimwipe or paper towel.
18. Place sealed liners in zip-top plastic bags and seal the bags. Pack samples in a chilled cooler.
19. In the field logbook and on the boring log, describe sample lithology by observing cuttings and the bottom end of the sample in the liner.
20. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.
21. When sampling is complete, remove the drilling rig to the heavy equipment decontamination site.
22. Dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.
23. Decontaminate split spoons and other small sampling equipment before proceeding to other sampling locations as required by the CDM Federal SOP 4-5.

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24. Complete the field logbook entry, and other forms, being sure to record all relevant information before leaving the site.
25. Properly package all samples for shipment to laboratories and complete all necessary sample shipment documentation. Remand custody of the samples to the appropriate personnel. See CDM Federal SOPs 1-2 and 2-5 or site-specific plans.

5.2.7 Shelby Tube Sampling

The following steps must be followed when collecting samples using the Shelby tube:

1. Remove any pavement and subbase material from an area of twice the bit diameter, if necessary.
2. The drilling rig will be decontaminated at a separate location prior to drilling.
3. Attach the hollow-stem auger with the cutting head, plug, and center rod(s).
4. Begin drilling and proceed to the first designated sample depth, adding auger flight(s) as necessary.
5. Slightly raise the auger flight(s) to disengage the cutting head, and rotate the auger without advancement to clean cuttings from the bottom of the hole.
6. Remove the plug and center rods.
7. Attach a head assembly to a decontaminated Shelby tube. Attach the Shelby tube assembly to the center rods.
8. Lower the Shelby tube and center rods into the hollow-stem augers and seat it at the bottom. Be sure to leave 30 inches or more of center rod above the lowest point to the hydraulic piston's extension.
9. Use the rig's hydraulic drive to push the Shelby tube into undisturbed soil. The tube should be pushed with a steady force. Note the pressure used to push the Shelby tube in the field logbook.
10. When the Shelby tube has been advanced its full length or to refusal, back off the hydraulic pistons. Attach a hoisting plug to the upper end of the center rod, twist to break off the sample, and pull the apparatus out of the hole with the rig winch.

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11. Retrieve the Shelby tube to the surface, detach it from the center rod, and remove the head assembly.
12. Since the typical intent of Shelby tube sampling is for engineering purposes and an undisturbed sample is required, the tube ends should be sealed immediately. Sealing is accomplished by filling any void space in the tube with beeswax, then placing caps on the ends of the tube and taping caps into place. The top and bottom ends of the tube should be marked and the tube transported to the laboratory in an upright position. Indicate boring/well number and depth on outside of liner.
13. Wipe sealed tubes clean with a clean Kimwipe or paper towel.
14. Place sealed tubes in zip-top plastic bags and seal bags. Pack samples in a chilled cooler.
15. Continue to advance the borehole to the next sampling point. Collect samples as outlined above.
16. When sampling is complete, remove the drilling rig to the heavy equipment decontamination area.
17. Dispose of cuttings, plastic sheeting, etc., as specified in the site-specific plans.
18. Complete the field logbook entry, being sure to record all relevant information before leaving the site. These methods may be used if directed by the EPA Region, client or governing sample plan.

6.0 RESTRICTIONS/LIMITATIONS

Basket or spring retainers may be needed for split-spoon sampling in loose, sandy soils.

Shelby tubes may not retain the sample in loose, sandy soils.

7.0 REFERENCES

American Society for Testing and Materials, *Penetration Test And Split Barrel Sampling Of Soils*, Standard Method D-1586-84, 1984.

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U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Quality Control Requirements For Field Methods*, DOE/HWP-69/R1, July 1990.

U.S. Department of Energy, Hazardous Waste Remedial Actions Program, *Standard Operating Procedures For Site Characterizations*, DOE/HWP-100, July 1990.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, November 1986, (as amended by Update III, June 1997). Method 5035: Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.

WATER LEVEL MEASUREMENT

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Prepared: [Signature]

Signature/Date

Technical Review: [Signature]

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QA Review: [Signature]

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Approved: [Signature]

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Issued: [Signature]

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1.0 OBJECTIVE

Water-level measurements are fundamental to groundwater and solute transport studies and are conducted during groundwater sampling events to calculate purging requirements. This standard operating procedure (SOP) defines the techniques and requirements for taking groundwater level measurements.

2.0 BACKGROUND

2.1 Definitions

Water Level Indicator - A portable device for measuring the depth from a fixed point at the ground surface or above the ground surface to the groundwater inside a well, borehole or other underground opening.

Measurement Point - An easily located and clearly defined mark at the top of a well or borehole from which all water level measurements from that particular well are made. The measurement point should be as permanent as possible to provide consistency in measurements.

Electrical Tape - A graduated plastic tape, onto which a water-sensitive electrode is connected that will electronically signal the presence of water (circuit closure).

Immiscible Fluids - Two or more fluid substances that will not mix, and therefore will exist together in a layered form. The fluid with the highest density will exist as the bottom layer, the fluid with the lowest density will exist as the top layer, and any other fluid layers will be distributed relative to their respective densities.

Discharge - Depletion of water from the zone of saturation.

Recharge - The addition of water to the zone of saturation.

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Static Water Level - The level of water in a well that is not influenced by discharge or recharge.

Well Riser - A steel, stainless steel, or polyvinyl chloride (PVC) pipe that extends into a borehole and is connected to the well screen or sealed at the bedrock surface in open-hole wells. The well riser is normally enclosed by an outer steel protective casing.

Protective Casing - A steel cylinder or square protective sleeve extending approximately 3 to 5 feet into the ground, surrounding the well riser, and may extend above the ground surface approximately 2 to 3 feet. The protective casing protects the well riser.

2.2 Discussion

Major uses of static water level data are to determine the direction of groundwater flow, to identify areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relations. Specific uses for water level data may include:

1. Determine the change in water level due to distribution or rate of regional groundwater withdrawal.
2. Show the relationship of groundwater to surface water.
3. Estimate the amount, source, and area of recharge and discharge.
4. Determine rate and direction of groundwater movement.

Water levels should be measured in each well prior to purging, sampling, or other disturbance of the water table.

2.3 Associated Procedures

- CDM Federal SOP 1-5, Groundwater Sampling Using Bailers
- CDM Federal SOP 4-1, Field Logbook Content and Control
- CDM Federal SOP 4-3, Well Development and Purging
- CDM Federal SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites

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3.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that measurements are conducted in accordance with this procedure and any other SOP pertaining to site activities related to obtaining groundwater level measurements.

Field Team Leader - The Field Team Leader is responsible for ensuring that field personnel take water level measurements in accordance with this and other relevant procedures.

4.0 REQUIRED EQUIPMENT

4.1 General

- Site-specific plans
- Field logbook
- Indelible black ink pens
- Permanent felt-tip marker (e.g., Sharpie)
- Decontamination equipment and supplies, including rinse bottles and deionized water
- Personal protective clothing and equipment
- Tap water and large beaker or bucket

4.2 Measuring Devices

The equipment required to obtain water level measurements is dependent on the type of procedure chosen. Measurements may be made with a number of different devices and procedures. Measurements are taken to a permanent measurement point on the well riser.

When a choice exists, electrical tapes are preferred over other devices such as steel tape due to the electrical tape's simplicity and ability to make measurements in a short period of time. Many types of electrical instruments have been devised for measuring water levels; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Examples of electrical tapes that are frequently used include the Slope Indicator Co. and Solinst electronic water level indicators. These instruments are powered by batteries that should be checked prior to mobilization into the field.

Electrical tapes are coiled on a hand-cranked reel unit that contains batteries and a signaling device that indicates when the circuit is closed (i.e., when the probe reaches the water). Electrodes are generally contained in a weighted probe that keeps the tape taut in addition to providing some shielding of the electrodes against false indications as the probe is being lowered into the hole. The electrical tapes are marked with 0.01-foot increments. Caution should be exercised when using electrical tapes when the

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water contains elevated amounts of dissolved solids. Under these conditions, the signaling device will remain activated after the probe is removed from the water. When the water being measured contains very low amounts of dissolved solids, it is possible for the probe to extend several inches below the water level prior to activating the signaling device. Both of these conditions are related to the conductivity of the water and in some cases may be compensated for by the sensitivity control, if the device has this option.

Steel surveying tapes in lengths of 100, 200, and 300 feet (as appropriate for site geology) are coiled on a hand-cranked reel. They are weighted at the free end to ensure straight-line measurements are made. The lower few feet of tape are chalked by pulling the tape across a piece of blue carpenter's chalk. After the tape is lowered to the water level and retrieved, the wet chalk mark identifies the portion of the tape that was submerged. This distance is subtracted from the measurement taken at the top of the well (the measurement point). This method of obtaining water level measurements is not recommended for use in monitoring wells where the introduction of chalk into the well may affect the integrity of groundwater samples. The tape used should be capable of being read to 0.01-foot increments. Steel surveying tapes may be used when conditions prohibit the use of other devices. If a steel surveying tape is used, the following items of caution should be noted:

- The steel tape has tremendous tensile strength but will snap very easily when kinked.
- The steel tape has more surface area than round cables and may stick to the sides of casing or boreholes.
- Deep water levels may be difficult to measure because the chalk will become wet due to the condensation inside wells.

5.0 PROCEDURES

5.1 Preparation

The following steps must be taken when preparing to take a water level measurement:

- Assign a designated field logbook to record all field events and measurements according to CDM Federal SOP 4-1. Document any and all deviations from SOPs and site-specific plans in the logbook and include rationale for the changes.
- Standing upwind from the well, open the groundwater well. Monitor the well with a photoionization detector (PID), flame ionization detector (FID), or equivalent vapor analyzer as soon as the cap is opened, as dictated by the site-specific health and safety plan.

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For comparability, water level measurements should always be referenced to the same vertical (elevation) datum marker, such as a U. S. Geological Survey (USGS) vertical and horizontal control point monument. Elevation datum obtained from the measurement of static water levels should be referenced to Mean Sea Level unless otherwise specified in the site-specific plans.

The measurement point must be as permanent as possible, clearly defined, marked, and easily located. Frequently, the top of the PVC riser is designated as the measurement point. However, since the top of the riser is seldom smooth and horizontal, one particular point on the riser pipe should be designated and clearly marked. This can be accomplished by marking a point on the top of the riser pipe with a permanent marker. To avoid spilling liquids into the well, paints or other liquid marking materials should not be used. The protective outer casing can also be used as the measurement point if required. However, due to frost heave or other outside influences, which may change the casing elevation, this is less desirable than the well riser pipe.

5.2 Electronic Water Level Indicators

The following steps must be followed when taking water level measurements using electrical tapes:

1. Before lowering the probe into the well, the circuitry should be checked by dipping the probe in tap water and checking to ensure that the signaling device responds to probe submergence. The probe should then be lowered slowly into the well until contact with the water surface is indicated. The electrical tape reading is made at the measuring point. Take a second check reading before completely withdrawing the tape from the well to verify the measurement.
2. Independent electrical tape measurements of static water levels using the tape should agree within ± 0.01 foot for depths of less than about 200 feet. At greater depths, independent measurements may not be this close. For a depth of about 500 feet, the maximum difference of independent measurement using the same tape should be within ± 0.1 foot.
3. Decontaminate the electrical tape according to CDM Federal SOP 4-5 before proceeding to the next well to minimize cross contamination.
4. It may be necessary to check the electrical tape length with a graduated steel tape after the line has been used for a long period of time (e.g., one year) or after it has been pulled hard in attempting to free the line. Some electrical tapes, especially the single line wire, are subject to permanent stretch. Because the probe is larger in diameter than the wire, the probe can become lodged in a well that may contain pumps or other groundwater measuring equipment.

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Date: September 30, 1996

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FIELD MEASUREMENT OF ORGANIC VAPORS

Prepared: Charles Lutz

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9/18/96
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Issued: [Signature]

9/25/96
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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for the measurement of organic vapors in the field.

2.0 BACKGROUND

2.1 Definitions

Flame Ionization Detector - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the flame ionization of organic vapors.

Photoionization Detector - A portable, hand-held instrument that measures the concentration of gaseous organic compounds through the photoionization of organic vapors.

2.2 Discussion

The measurement of organic vapors is a required step during numerous field activities. The primary purpose of such measurements is health and safety monitoring to determine if the breathing zone in a work area is acceptable or if personal protective equipment such as a respirator or a supplied air device is necessary for field personnel. In addition to health and safety monitoring, organic vapor measurement also is used in conjunction with sampling activities, including subsurface soil sampling and groundwater sampling, where measurements are useful for establishing approximate contaminant levels or ranges.

The two types of instruments most commonly used to measure organic vapors are photoionization detectors (PIDs) and flame ionization detectors (FIDs). Both instruments first ionize the gaseous compound and then measure the response, which is proportional to the concentration. The PID ionizes the gas using an ultraviolet lamp. The photons emitted by the ultraviolet lamp are absorbed by the gas molecules, producing a positively-charged ion and an electron. The ionization potential (in electron volts) of the organic compounds to be measured must be less than energy carried by the photons; therefore, the ionization potential of the known or suspected compounds should be checked against the energy of the ultraviolet lamp to verify that the energy provided by the lamp is greater. The FID ionizes

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the gas by burning in a hydrogen/air flame. The FID allows measurement of a wide variety of compounds but in general its sensitivity is not as high as the PID.

2.3 Associated Procedures

- CDM Federal SOP 1-4, Subsurface Soil Sampling
- CDM Federal SOP 1-5, Groundwater Sampling Using Bailers
- CDM Federal SOP 1-6, Water Level Measurement
- CDM Federal SOP 3-1, Geoprobe Soil Sampling Survey
- CDM Federal SOP 3-5, Lithologic Logging
- CDM Federal SOP 4-3, Well Development and Purging

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that field activities are conducted in accordance with the procedure and any other SOPs pertaining to the specific activity.

Field Team Leader - The Field Team Leader is responsible for ensuring that field personnel conduct field activities in accordance with this and other relevant procedures.

4.0 REQUIRED EQUIPMENT

- Site-specific plans
- Field logbook
- Waterproof black ink pen
- Personal protective clothing and equipment
- Photoionization detector or flame ionization detector
- 16-ounce or "mason" type glass jar
- Hydrogen Canister (if using FID for a period of more than one day)

5.0 PROCEDURES

5.1 Direct Reading Measurement

1. Connect measurement probe to instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.

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2. Calibrate the instrument following the applicable CDM Federal Equipment Procedure and/or the manufacturer's manual. The following Equipment Procedures may apply :
 - EP No. C.2 - OVM/Data Logger, Model 580
 - EP No. C.3 - HNU Model PI 101/Photoionization Analyzer
 - EP No. C.4 - Century OVA 128, Portable Organic Vapor Analyzer
3. Make sure the instrument is reading zero and all function and range switches are set appropriately.
4. Insert the end of the probe directly into the atmosphere to be measured (e.g., breathing zone, monitoring well casing, split spoon, etc.) and read the organic vapor concentration in ppm from the instrument display. Record the highest instrument response.
5. Immediately document the reading in the field logbook or on the appropriate field form.

5.2 Headspace Measurement

1. Connect measurement probe to instrument and make necessary operational checks (e.g., battery check, etc.) as outlined in the manufacturer's manual.
2. Calibrate the instrument following the appropriate CDM Federal Equipment Procedure and/or the manufacturer's manual. See Section 5.1, step 2 for potentially applicable Equipment Procedures.
3. Make sure the instrument is reading zero and all function and range switches are set appropriately.
4. Fill a clean glass jar approximately half-full of the sample to be measured. Quickly cover the top of the jar with one or two sheets of clean aluminum foil and apply cap to seal the jar.
5. Allow headspace to develop for approximately 10 minutes. It is generally preferable to shake the sealed jar for 10 to 15 seconds at the beginning and end of headspace development. **NOTE:** When the ambient temperature is below 32°F (0°C), the headspace development and subsequent measurement should occur within a heated vehicle or building.
6. Remove the jar cap and quickly puncture and insert the instrument probe to a point approximately one-half of the headspace depth.
7. Read the organic vapor concentration in ppm from the instrument display. Record the highest instrument response.

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4.0 REQUIRED EQUIPMENT

- Coolers with return address of CDM Federal office
- Heavy-duty plastic garbage bags
- Plastic zip-top bags, small and large
- Clear Tape
- Fiber tape
- Duct tape
- Vermiculite (or equivalent)*
- Bubble wrap (optional)
- Ice
- Chain-of-Custody seals
- Completed Chain-of-Custody record or CLP custody records if applicable
- Completed Bill of Lading
- "This End Up" and directional arrow labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

5.0 PROCEDURES

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "Environmental Sample" and are not a hazardous material as defined by DOT. Professional judgement and/or consultation with the appropriate Health and Safety Coordinator or the Health and Safety Manager should be observed.
2. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape. Line the cooler with a large heavy-duty plastic garbage bag.
3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).
4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. Note: Trip blanks must be included in coolers containing VOA samples.

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5. Place two to four inches of vermiculite (or equivalent) into a cooler that has been lined with a trash bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of more packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.
6. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at less than or equal to 4° Centigrade. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.
7. Place the completed Chain-of-Custody Record or the CLP Traffic Report Form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.
8. Fiber tape shall be wrapped around each end of the cooler two times, and completed Chain-of-Custody seals affixed to the top opposite sides of the cooler, half on the fiber tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape; place clear tape over custody seals.
9. The shipping container lid must be marked "THIS END UP" and arrow labels which indicate the proper upward position of the container should be affixed to the cooler. A label containing the name and address of the shipper (CDM Federal) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the Bill of Lading shall be completed and attached to the lid of the shipping container.

6.0 RESTRICTIONS/LIMITATIONS

The holding times for the samples packed for shipment must not be exceeded. It is recommended that samples be packed in time to be shipped nightly for overnight delivery. Use caution when shipping samples for weekend delivery; make arrangements with laboratory before sending samples.

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7.0 REFERENCES

U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

U.S. Environmental Protection Agency, Region IV, *Standard Operating Procedures and Quality Assurance Manual*, February 1991.

GUIDE TO HANDLING INVESTIGATION-DERIVED WASTE

SOP: 2-6

Revision: 1

Date: February 18, 1999

Page: 1 of 10

Prepared: Jeff Weatherly

Technical Review: Larry Davidson

QA Review: David O. Johnson

Approved: [Signature] 2/23/99

Issued: Rosemary Gustin 2/24/99
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1.0 OBJECTIVE

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed prior to field activities.
- Remove wastes which pose an immediate threat to human health or the environment.
- Proper handling of onsite wastes that do not require offsite disposal or extended above-ground containerization.
- Complying with federal, state, and facility applicable or relevant and appropriate requirements (ARARs).
- Careful planning and coordination of IDW management options.
- Minimizing the quantity of IDW.

2.0 BACKGROUND

2.1 Definitions

Hazardous Waste - Waste that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes (IDWs) - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, liquid, or gaseous, or multiphase materials that may be classified as hazardous or nonhazardous.

Mixed-Waste - Any material that has been classified as hazardous and radioactive.

Radioactive Wastes - Wastes that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

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Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities which accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the Environmental Protection Agency (EPA) and appropriate state agencies.

2.2 Discussion

Field investigation activities result in the generation of waste materials that may be characterized as a hazardous or radioactive waste. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

NOTE: The Clients representatives may not be aware of all potential contaminants. The management of IDW must comply with regulatory requirements that are applicable.

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The Site Manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager - The Project Manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members – Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the Project Manager's attention.

4.0 REQUIRED EQUIPMENT

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required should consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

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4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site-or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 mils.
- DOT approved steel containers.
- Bulk storage tanks comprised of polyethylene or steel.

Containment of IDW should be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device should be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking should be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are:

- Labels and markings that contain the following information: project name; generation date; location of waste origin; container identification number; sample number (if applicable); contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers five-gallons or less may only require one label or set of markings.
- Positioning labels or markings on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported offsite must be in accordance with the requirements of 49 CFR 172.

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4.3 IDW Container Movement

Staging areas for IDW containers should be predetermined and in accordance with site-specific and /or client requirements. Arrangements should be made prior to field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation offsite onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW should be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. Secondary/spill container must be provided as appropriate.

5.0 PROCEDURES

The three general options for managing IDW are (1) collection and onsite disposal; (2) collection for offsite disposal; and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected should take into account the following factors:

- Type, quantity and source of IDW (soil, sludge, liquid, debris).
- Risk posed by managing the IDW on site.
- Compliance with regulatory requirements.
- IDW minimization, and consistency with the IDW remedy and the site remedy.

In all cases the client should approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Onsite Disposal

5.1.1 Soil/Sludge/Sediments

The options for handling soil/sludge/sediment IDW are as follows:

- A. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

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- B. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).
- C. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).
- D. Send to onsite Treatment, Storage and Disposal Facility (TSDF) - may require analytical analysis prior to treatment/disposal.

NOTE: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

- A. Discharge to surface water, only when IDW is not contaminated.
- B. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern nor associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.
- C. Discharge to sanitary sewer.
- D. Send to onsite TSDF - may require analysis prior to treatment/disposal.

NOTE: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposable PPE

The options for handling disposable PPE are as follows:

- A. Double-bag contents in non-transparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.
- B. Containerize, label, and send to TSDF - may require analysis prior to treatment/disposal.

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5.2 Offsite Disposal

Before sending to a TSDF, analysis may be required. Also, manifests are required. Arrangements must be made with the client responsible for the site; it is **CDM Federal's policy not to sign manifests**. The TSDF and transporter must be permitted for the respective wastes.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected should take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums) until final disposal. The management option selected should take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires offsite treatment disposal, the IDW may be containerized and stored. The management option selected should take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Interim Measures

All interim measures must be approved by the client and regulatory agencies.

A. Storing IDW onsite until the final action may be practical in the following situations:

1. Returning wastes (especially sludges and soils) to their onsite source area would require re-excavation for disposal in the final remediation alternative.
2. Interim storage in containers may be necessary to provide adequate protection to human health and the environment.

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3. Offsite disposal options may trigger land disposal regulations under RCRA. Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
 4. Interim storage may be necessary to provide time for sampling and analysis.
- B. Segregate and containerize all waste for future treatment and/or disposal.
1. Containment options for soil/sludge/sediment may include drums or covered waste pile in AOC.
 2. Containment options for aqueous liquids may include mobile tank or drums.
 3. Containment options for PPE may include drums or roll-off boxes.

6.0 RESTRICTIONS/LIMITATIONS

SITE MANAGERS SHOULD DETERMINE THE MOST APPROPRIATE DISPOSAL OPTION FOR AQUEOUS LIQUIDS ON A SITE-SPECIFIC BASIS. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **UNDER NO CIRCUMSTANCES SHOULD THESE TYPES OF MATERIALS BE BROUGHT BACK TO THE OFFICE OR THE WAREHOUSE.**

7.0 REFERENCES

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ATTACHMENT 1 IDW MANAGEMENT OPTIONS

TYPE OF IDW	GENERATION PROCESSES	MANAGEMENT OPTIONS
Soil	<ul style="list-style-type: none"> • Well/test pit installations • Borehole drilling • Soil sampling 	<p>Onsite Disposal</p> <ul style="list-style-type: none"> • Return to boring, pit, or source immediately after generation • Spread around boring, pit, or source within the Area of Contamination (AOC) • Consolidate in a pit (within the AOC) • Send to onsite Treatment/Storage and Disposal Facility (TSDF) <p>Offsite Disposal</p> <ul style="list-style-type: none"> • Client to send to offsite TSDF <p>Interim Management</p> <ul style="list-style-type: none"> • Store for future treatment and/or disposal
Sludge/sediment	<ul style="list-style-type: none"> • Sludge pit/sediment sampling 	<p>Onsite Disposal</p> <ul style="list-style-type: none"> • Return to boring, pit, or source immediately after generation • Send to onsite TSDF <p>Offsite Disposal</p> <ul style="list-style-type: none"> • Client to send to offsite TSDF <p>Interim Management</p> <ul style="list-style-type: none"> • Store for future treatment and/or disposal
Aqueous liquids (groundwater, surface water, drilling fluids, wastewaters)	<ul style="list-style-type: none"> • Well installation/development • Well purging during sampling • Groundwater discharge during pump tests • Surface water sampling • Waste water sampling 	<p>Onsite Disposal</p> <ul style="list-style-type: none"> • Discharge to surface water • Pour onto ground close to well (nonhazardous waste) • Discharge to sewer • Send to onsite TSDF <p>Offsite Disposal</p> <ul style="list-style-type: none"> • Client to send to offsite commercial treatment unit • Client to send to publicly owned treatment works (POTW) <p>Interim Management</p> <ul style="list-style-type: none"> • Store for future treatment and/or disposal
Decontamination fluids	<ul style="list-style-type: none"> • Decontamination of PPE and equipment 	<p>Onsite Disposal</p> <ul style="list-style-type: none"> • Send to onsite TSDF • Evaporate (for small amounts of low contamination organic fluids) • Discharge to ground surface

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ATTACHMENT 1 (continued) IDW MANAGEMENT OPTIONS

TYPE OF IDW	GENERATION PROCESSES	MANAGEMENT OPTIONS
Disposable Personal Protective Equipment (PPE)	<ul style="list-style-type: none">• Sampling procedures or other onsite activities	<p>Offsite Disposal</p> <ul style="list-style-type: none">• Client to send to offsite TSDF• Discharge to sewer. <p>Interim Management</p> <ul style="list-style-type: none">• Store for future treatment and/or disposal <p>Onsite Disposal</p> <ul style="list-style-type: none">• Place in onsite industrial dumpster• Send to onsite TSDF <p>Offsite Disposal</p> <ul style="list-style-type: none">• Client to send to offsite TSDF <p>Interim Management</p> <ul style="list-style-type: none">• Store for future treatment and/or disposal

Adapted from U.S. Environmental Protection Agency, Guide to Management of Investigation-Derived Wastes, 9345-03FS, January 1992.

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the requirements for collecting soil, soil gas, and groundwater samples using the Geoprobe sampling system. Geoprobe is a tradename proprietary to Geoprobe Systems of Salina, Kansas.

2.0 BACKGROUND

2.1 Discussion

The Geoprobe unit consists of a hydraulically operated, hammer device mounted in the back of a van or pickup truck (Figure 1). The Geoprobe system hydraulically advances small-diameter, hollow rods to the desired sampling depth. The specific type of Geoprobe sampling equipment for soil, soil gas, and groundwater collection is then employed.

The use of Geoprobe technology may be a cost-effective alternative to using conventional drilling techniques for collecting subsurface soil, soil gas, and groundwater samples depending on the site-specific geologic and hydrogeologic conditions and sample requirements. The Geoprobe system is generally used to gather screening-level data. The site-specific sampling plans must consider such factors as soil types, presence of cobbles, depth to groundwater, quantity and depth of samples, site access and topography, data quality objectives (DQOs), analytical requirements, and waste handling and disposal requirements prior to selecting the use of the Geoprobe.

Advantages of using the Geoprobe include:

- Areas usually considered inaccessible by drill rigs because of overhead wires, steep slopes, size constraints, etc., may be accessed with the pickup truck or van-mounted Geoprobe.
- Investigation-derived wastes such as soil cuttings and purge water are minimized with the Geoprobe due to its small diameter rods and because it displaces soil horizontally, not vertically.

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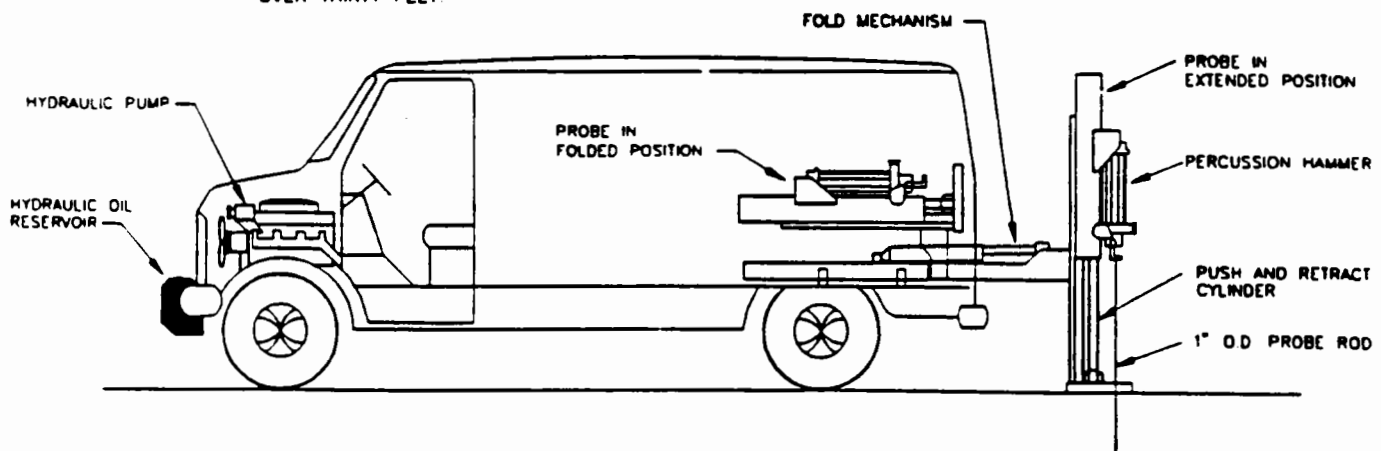
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**FIGURE 1
GEOPROBE UNIT**

BASICS

- HYDRAULICALLY POWERED PROBE OPERATES FROM HYDRAULIC SYSTEM DRIVEN FROM THE VEHICLE OR AN AUXILIARY ENGINE
- REMOTE VEHICLE IGNITION ALLOWS OPERATORS TO START VEHICLE ENGINE FROM REAR COMPARTMENT.
- BELT DRIVEN HYDRAULIC PUMP SUPPLIES 10 GPM AT 2000 RPM, 2250 PSI OPERATING PRESSURE.
- PROBE UNIT FOLDS FOR TRANSPORT AND SETS UP AGAIN IN SECONDS
- UTILIZES STATIC FORCE (WEIGHT OF VEHICLE) AND PERCUSSION TO ADVANCE PROBING TOOLS.
- POWERFUL 8 HP HYDRAULIC HAMMER DELIVERS OVER 1800 BLOWS PER MINUTE.
- HAMMER FEATURES 0-300 RPM LH DIRECTIONAL ROTARY FUNCTION FOR DRILLING SURFACE PAVEMENTS.
- PROBE HAS GREATER THAN 12,000 LBS. OF PULLING CAPACITY.
- DRIVES SMALL DIAMETER (1" O.D. - 1.6" O.D.) PROBING TOOLS TO DEPTHS LIMITED ONLY BY SOIL TYPE AND DEPTH TO BEDROCK, TYPICALLY TO OVER THIRTY FEET.



GEOPROBE SAMPLING

- Cost savings over conventional drilling techniques may be realized. The Geoprobe is rented/leased on a weekly or monthly basis or purchased for a fixed price as opposed to drilling subcontractors who are generally compensated based on the footage drilled; and the Geoprobe may be operated by field personnel rather than subcontractors. A cost evaluation based on project-specific requirements and site conditions should be conducted to determine the most cost-effective method for a particular project.

Two people are required to operate the Geoprobe and conduct sampling and recordkeeping activities. Safety considerations should be addressed when operating the Geoprobe. A safety hazard is present whenever the Geoprobe is operated. The hydraulic system operates with a fluid pressure of over 2,000 pounds per square inch (psi). A leaking hose may produce a stream of hydraulic fluid with sufficient pressure to penetrate skin. Therefore, periodic checks of the hydraulic lines and hoses should be conducted to ensure they are in good condition and connections are tight. Do not attempt to repair or tighten hoses with the engine running and the system under pressure. Use paper or cardboard to check for leaks.

2.2 Definitions

Geoprobe - A hydraulically operated, hammer device installed in the back of a van or pickup truck, used to advance a hollow-stem rod into the soil for the purpose of collecting soil, soil gas, or groundwater samples.

Probe-Drive Sampler - A sampling device, similar to a split-spoon sampler, used to collect soil samples with a Geoprobe rig. Three types of soil samplers are available: standard (in 10- and 24-inch lengths), large bore (with an acetate liner), and Kansas stainless.

Extension Rod - Stainless steel rod used to remove stop-pin and drive-point assembly.

Extension Rod Coupler - Stainless steel connector used to join sections of extension rods.

Drive Point - Solid steel retractable point used to advance sample collection device to the required sample depth.

Probe Rod - Hollow, flush-threaded, steel rod similar to a drill rod.

Stop-Pin - Steel plug that threads into the top of the drive cap to hold the drive point in place during advancement of the probe rods.

Drive Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when advancing the probe rods with the hydraulic hammer.

GEOPROBE SAMPLING

Pull Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when retracting the probe rods.

Extruder Rack and Piston - A device used in conjunction with the Geoprobe to force soil sample volume out of the sample tube.

Screen Point Groundwater Sampler - A groundwater sampling device designed for use with the Geoprobe consisting of a well screen encased in a perforated stainless steel sleeve.

Mill-slotted Well Rod and Point - A groundwater sampling device designed for use with the Geoprobe consisting of a Geoprobe probe rod with 15-mil slots, each 2" long x 0.020" wide.

Post-Run Tubing System (PRT) - The Geoprobe soil vapor sampling system utilizes disposable polyethylene or teflon tubing (inserted into the probe rods at the desired sampling depth) and a vacuum.

Expendable Drive Point - Solid steel point attached to the end of the screen point groundwater sampler and PRT expendable point holder.

2.3 Associated Procedures

- SOP 1-2, Sample Custody
- SOP 1-5, Groundwater Sampling Using a Bailer
- SOP 1-6, Water Level Measurements
- SOP 2-5, Packaging and Shipping of Environmental Samples
- SOP 4-1, Field Logbook Content and Control
- SOP 4-3, Well Development and Purging
- SOP 4-5, Field Equipment Decontamination

3.0 RESPONSIBILITIES

Field Team Leader (FTL) - The FTL is responsible for ensuring that sampling efforts are conducted in accordance with this procedure, associated SOPs, and the site-specific plans.

Sampling Personnel - Field team members are responsible for conducting Geoprobe sampling events in accordance with this procedure, all associated SOPs, and requirements as described in the site-specific plans.

GEOPROBE SAMPLING

4.0 REQUIRED EQUIPMENT

General

- Site-specific plans
- Field logbook, chain-of-custody forms, other forms for documenting sample shipment, and indelible black or blue ink pens and markers
- Sample containers with labels and preservatives, insulated coolers, bagged ice or "blue ice", plastic zip-top bags, and waterproof sealing tape
- Temperature, conductivity, pH, dissolved oxygen, and turbidity meters (with clean beakers or other appropriate containers), as required by the site-specific plans
- Monitoring/Screening instruments as required by the site-specific health and safety plan or sampling plan
- Decontamination supplies, as required by SOP 4-5
- Personal protective equipment (PPE), as required by the site-specific health and safety plan (at a minimum, hard hat, steel-toed shoes, safety glasses, and hearing protection are required)
- Latex or appropriate gloves
- Geoprobe rig (van, truck, or skid-mounted) with the following:
 - Probe rods (1, 2, and 3-foot lengths)
 - Extension rods (1, 2, and 3-foot lengths), couplers, and handle
 - Piston stop pins (two each per rig, minimum)
 - Drive caps and pull caps (two each per rig, minimum)
 - Carbide-tipped drill bit for working in concrete- or asphalt-covered areas
 - O-rings

Geoprobe Soil Sampling Equipment

- Extruder rack and piston (if soil is to be extruded into a sample container - otherwise, the steel sample tube with the Standard and Kansas Samplers or acetate liner with the Large Bore Sampler may be shipped to the laboratory, as indicated in the site-specific plans)

GEOPROBE SAMPLING

- Assembled soil samplers (i.e., Standard 10-inch or 24-inch Sampler, Kansas Stainless Sampler, or Large Bore Sampler - refer to the Geoprobe Systems Equipment and Tools Catalog for specific parts for each sampler)

Geoprobe Soil Gas Sampling Equipment

- Expendable drive points (one each per sample location, plus spares)
- Extension rod ram
- 3/8" Polyethylene (Teflon® lined) tubing and PRT adapter
- Vacuum or sampling system
- Syringe
- PRT adapter
- PRT expendable point holder

Geoprobe Groundwater Sampling Equipment

- Expendable drive points (one each per sample location, plus spares)
- Mill-slotted well point or Screen Point groundwater sampler assemblies
- Extension rod ram
- 3/8" Polyethylene (Teflon® lined) tubing
- Check valves (if using Waterra system)
- Peristaltic pump
- Mini-bailer (and thin nylon line)

5.0 PROCEDURES

Procedures common to all three sampling methods are discussed below.

Prior to sampling:

- Arrange utility clearance.
- Decontaminate all Geoprobe equipment according to SOP 4-5, Field Equipment Decontamination.
- Don the appropriate PPE as dictated by the site-specific health and safety plan.
- If the sampling site is in a concrete- or asphalt-covered area, drill a hole using the rotary function and a specially designed 1.5-inch or 2.0-inch diameter carbide-tipped drill bit.

GEOPROBE SAMPLING

Otherwise, area needs to be cleared of heavy underbrush and immediate overhead obstructions.

After sampling is completed:

- Thread the pull cap onto the top probe rod and retract the probe rods.
- Seal the borehole with sand, neat cement or bentonite grout, if necessary.
- Record all appropriate data in the field logbook and the chain-of-custody forms as outlined in CDM Federal SOP 4-1 "Field Logbook Content and Control" and CDM Federal SOP 2-5 "Packaging and Shipping of Environmental Samples."
- Decontaminate the sampling equipment according to CDM Federal SOP 4-5 "Field Equipment."

5.1 Soil Sampling

Assembly

1. Assemble the sampling device as follows:
 - Screw the cutting shoe to the bottom end of the sample tube (unless using standard probe drive sampler which has built-in cutting edge).
 - Screw the piston tip onto the piston rod.
 - Screw the drive head onto the top end of the sample tube.
 - If using Teflon® liner, insert liner into sample tube.
 - Slide the piston rod into the sample tube, leaving the piston tip sticking out of bottom end of the sample tube.
 - Screw the piston stop pin onto the top end of the piston rod in a counter-clockwise direction.
2. Attach the assembled sampler onto the leading probe rod. A 12-inch probe rod is recommended to start the 24-inch standard and large bore samplers.

GEOPROBE SAMPLING

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 12-in. rod with a 36-in. rod as soon as the top of the sampler is driven to within 6 inches of the ground surface.
4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Stop Pin Removal

5. Move the probe unit back from the top of the probe rods and remove the drive cap.
6. Lower the extension rods into the inside diameter of the probe rods using extension rod couplers to join the extension rods.
7. Attach the extension rod handle to the top extension rod and rotate the handle clockwise until the leading extension rod is screwed into the piston stop pin. Continue to rotate the handle clockwise until the stop pin disengages from the drive head.
8. Remove the extension rods and attached piston stop pin from the probe rods.

Sampling

9. Replace the drive cap, mark the top probe rod with a marker or tape at a distance above the ground equal to the length of the sample tube (either 12 or 24 inches).
10. Advance the probe rods using the hydraulic hammer the length of the sample tube (either 12 or 24 inches).
11. Replace the drive cap with the pull cap and retract the probe rod(s). Secure the rod(s) with a clamp or by hand during removal so they do not fall back down the resulting borehole.
12. Detach the sampler from the lead probe rod, verifying that sufficient sample volume was recovered (the length of sample contained within the tube is approximately equal to the length of exposed piston rod).
13. Disassemble the sampler. If the sample is to be analyzed for VOCs, then the sample tube or liner should be sealed immediately by placing a Teflon® septa over the ends and covering them with plastic caps.

GEOPROBE SAMPLING

14. If samples do not require VOC analysis, they may be extruded from the sampler and transferred to the sample jars specified in the site-specific plans or SOP 2-5 "Packaging and Shipping of Environmental Samples." Samples can be extruded by one of two methods:
 - Using the Geoprobe rig and the extruder rack (Figure 2): position the extruder rack on the foot of the Geoprobe derrick; insert the sample tube into the extruder rack with cutting end up; and position the extruder piston and pushing the sample out of the sample tube using the "probe" function. Catch the sample as it exits beneath the extruder in a sample jar or stainless steel mixing bowl. Samples to be collected for VOCs will be collected directly from the sample tube into the sample jars.
 - By lightly tapping the side of the sample tube with a hammer while also lightly pushing the Piston Rod.
15. Label the sample liner or sample jars as required, securing the label by covering it with a piece of clear, waterproof tape.
16. Homogenize the sample in a stainless steel bowl with a stainless steel spoon or spatula. Transfer the sample from the bowl to the sample container.
17. Clean the outside of the sample jars and place individual samples into sealable bags and seal closure.
18. Place samples in a cooler containing ice, according to SOP 2-5 "Packaging and Shipping of Environmental Samples."

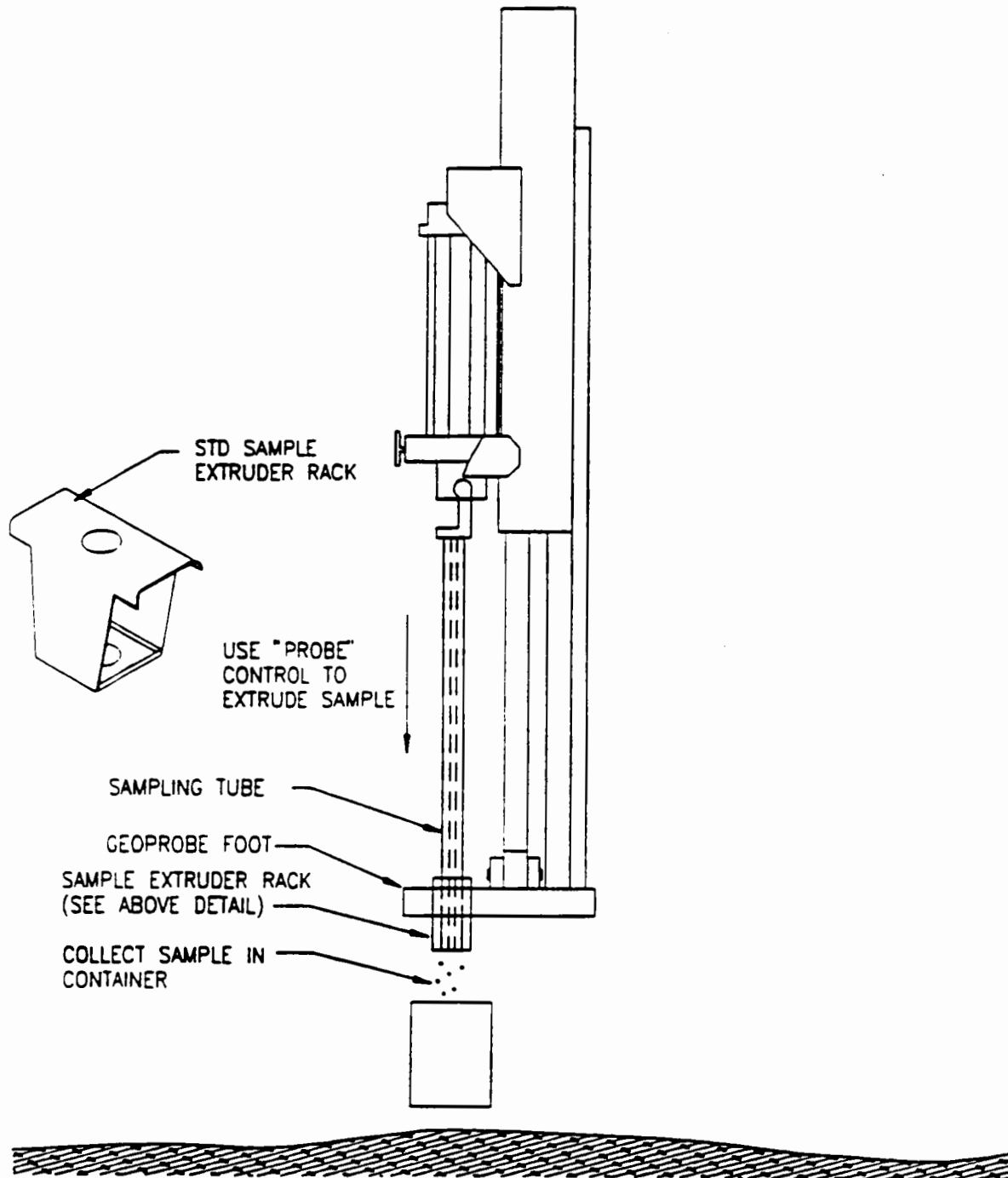
5.2 Soil Gas Sampling

Assembly

1. Assemble the sampling device as follows (Figure 3):
 - Test fit the adapter with the PRT expendable point holder or retractable point holder to ensure that threads are compatible and fit together smoothly.
 - Attach the PRT adapter to flexible tubing equal in length to the depth of sampling (with some additional for sampling activities).
 - Secure PRT adapter with a length of electrician's tape and check the condition of the O-ring attached to the end of the PRT adapter.

GEOPROBE SAMPLING

FIGURE 2
SAMPLE EXTRUDER RACK



GEOPROBE SAMPLING

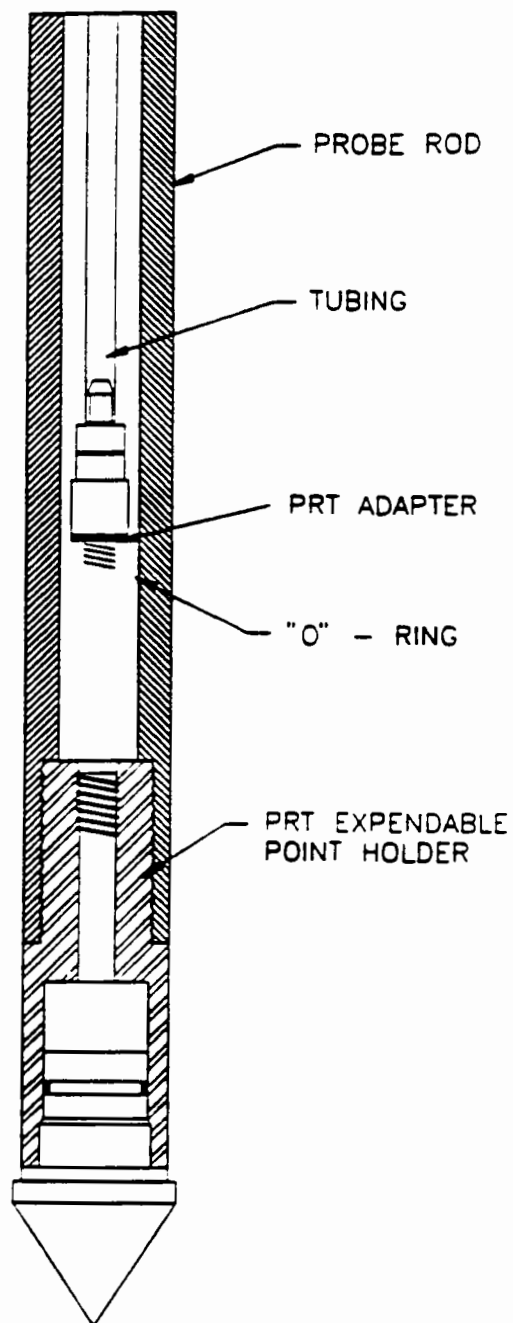
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FIGURE 3
PRT SOIL GAS SAMPLING SYSTEM



GEOPROBE SAMPLING

- Screw the PRT expendable point holder into the bottom of the lead probe rod.
 - Attach an expendable drive point to the bottom of the PRT expendable point holder.
2. Attach the assembled sampler onto the leading probe rod. A 12-in. probe rod is recommended to start the 24-in. standard and large bore samplers.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler. Replace the 12-in. rod with a 36-in rod as soon as the top of the sampler is driven to within 6 inches of the ground surface.
4. Advance the sampler to 1 foot past the interval to be sampled using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.

Sampling

5. Replace the drive cap with a pull cap and retract the probe rods approximately 1 foot.
6. Move the probe unit back from the top of the probe rods and remove the drive cap.
7. Push the drive point out of the PRT expendable drive point holder with extension rods fitted with a ram.
8. Remove the extension rods from the probe rods.
9. Insert the adapter end of the tubing down the inside diameter of the probe rods, feeding the tubing down until the adapter contacts the top of the PRT expendable point holder.
10. Holding the out-of-hole end of the tubing, apply downward pressure while turning in a counter-clockwise direction to screw the adapter into the PRT expendable point holder.
11. Pull lightly on the tubing to ensure that the threads have engaged.
12. Connect the out-of-hole tubing to a vacuum or sampling system. A short section of inert silicon tubing may be connected to the end of the out-of-hole tubing so that a sample can be collected with a glass gas chromatograph (GC) syringe.

GEOPROBE SAMPLING

13. Start the vacuum or sampling system and allow the system to operate for 2 to 3 minutes to ensure that a sufficient volume of air has been run through the tubing. Document the depth, vacuum pressure, and purge duration in logbook. **NOTE:** Make sure the vacuum evacuation pump is able to pull vapors from the formation. Excessive vacuum may occur in clay/clayey units resulting in insufficient sample volume.
14. Collect sample using the method specified in the site-specific plan.
15. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.
16. Remove the tubing from the probe rods. Dispose of the tubing or set it aside for decontamination.
17. Remove probe rod(s) from hole. Leave tubing in place for longer term monitoring.

5.3 Groundwater Sampling

Assembly

1. Assemble the screen point groundwater sampler (see Geoprobe Systems Equipment and Tools Catalog, Groundwater Sampling Tools, pp. 5.1-5.12) as follows (Figure 4):
 - Push the Screen Insert and Plug into the Screen Sleeve from the bottom. The bottom end has one drain hole.
 - Push the Screen Connector over the top end of the Screen Sleeve and push the Screen Connector Pin into place. The pin must be held in place as it has a loose fit.
 - Insert the Screen Sleeve, Screen Connector first, into one end of the Sampler Sheath.
 - Slide the Drive Point Seat over the end of the screen assembly that protrudes from the Sampler Sheath. Thread it in until tight using a 7/8" wrench.
 - Push the screen assembly just far enough into the Sampler Sheath that a Expendable Drive Point can be pushed into place in the Drive Seat.
 - Screw the GW Drive Head with the O-ring end first into the open end of the Sampler Sheath.

GEOPROBE SAMPLING

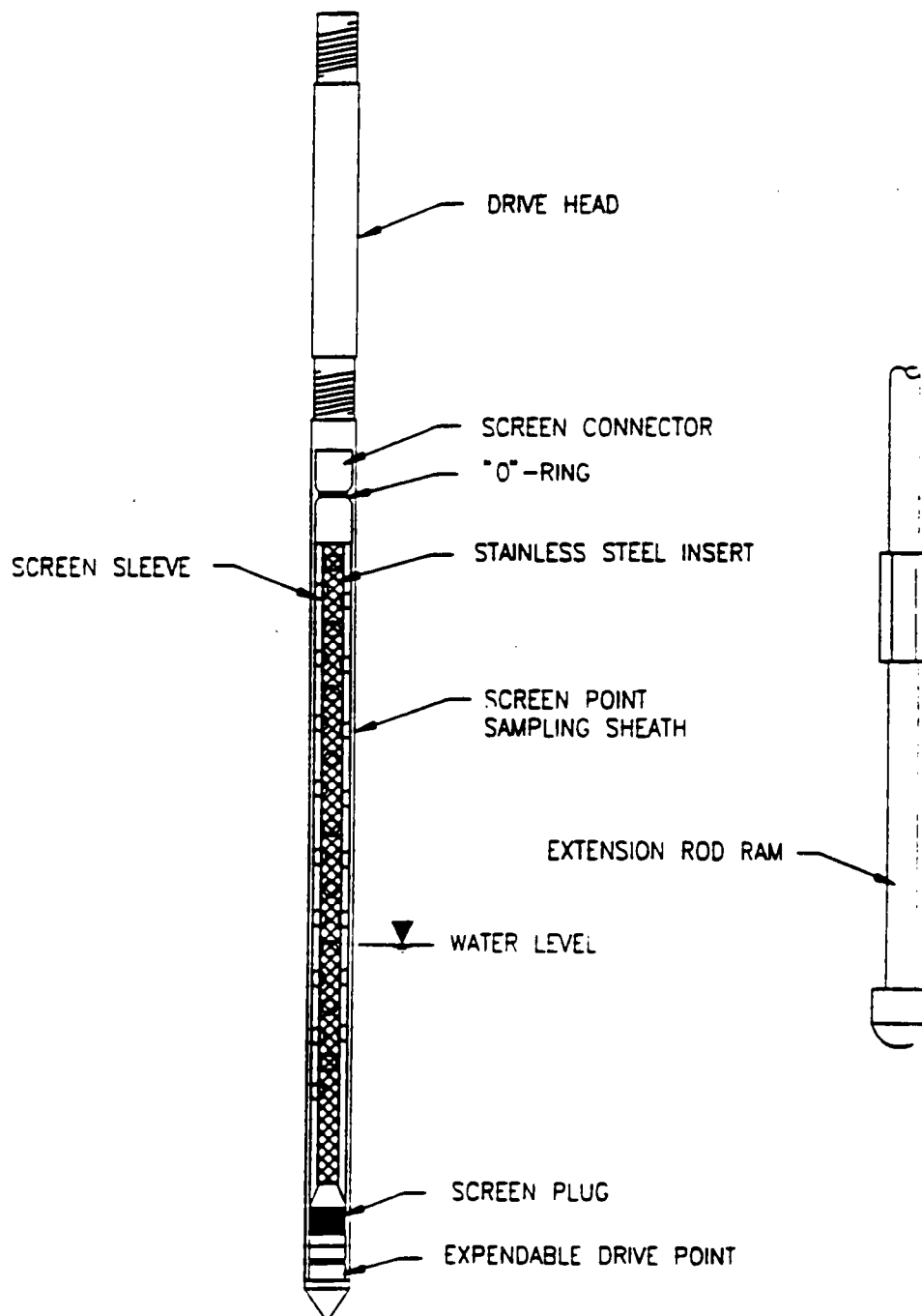
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FIGURE 4
GROUNDWATER SAMPLING



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- O-rings are installed at various critical places in the sampler assembly. Ensure that all O-rings have not been worn and that the connections made at O-ring locations are tight.

The Mill-slotted well point does not need any assembly.

2. Attach the Mill-slotted well point, or Screen Point groundwater sampler, onto the leading Probe Rod. A 12-in. Probe Rod is recommended to start either groundwater sampler.

Probing

3. Thread the Drive Cap onto the top of the Probe Rod and advance the sampler using either the hydraulic hammer or hydraulic probe mechanism on the Geoprobe rig. Replace the 12-in. rod with a 36-in rod as soon as the top of the sampler is driven to within 6 inches of the ground surface.
4. Advance the sampler to the interval to be sampled using the hydraulic hammer. Add additional Probe Rods as necessary to reach the specified sampling depth.

Sampling

5. Move the probe unit back from the top of the Probe Rods and remove the Drive Cap.
6. The next step varies depending on the type of sampler being used:
 - Mill-slotted well point - measure and record the water level, allowing time for the water level to reach equilibrium.
 - Screen Point groundwater sampler - attach the Pull Cap to the top Probe Rod, retract the Probe Rods approximately 2 feet, push the screen into the formation using extension rods fitted with a ram, remove extension rods from the probe rods, and measure and record the water level, allowing time for the water level to reach equilibrium.
7. Label all sample containers as required, securing the label by covering it with a piece of clear, waterproof tape.
8. Collect groundwater samples using one of three methods (as outlined in site-specific plans) described below:
 - Collect sample from the inside diameter of the Probe Rods using a decontaminated mini-bailer. Follow CDM Federal SOP 1-5 "Groundwater Sampling Using a Bailer."

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- Collect sample using a peristaltic pump and flexible tubing system.
 - Collect sample using a check valve (Waterra-type valve) attached to the bottom of 3/8-in. diameter tubing. The tubing is lowered into the probe rods below the top of the water table, check valve-end first. Water sample is collected through the tubing by rapidly oscillating the tubing up and down creating an inertia pump.
9. Clean the outside of the sample containers and place individual samples into sealable bags and seal closure.
 10. Place samples in a cooler, containing ice according to SOP 2-5 "Packaging and Shipping of Environmental Samples."

6.0 RESTRICTIONS/LIMITATIONS

The Geoprobe sampling system is not designed for collecting large sample volumes, thereby limiting the number of analytical parameters. Sample recovery rates may be reduced in soils with substantial amounts of gravel and/or cobbles. Depending on sampling depths and intervals, a typical sample production rate of between 10 and 15 samples per day can be expected.

The most efficient sampling depth is limited by the geologic and hydrogeologic conditions. Practical, efficient sampling depths should be limited to approximately 20 feet under most conditions. However, sampling depths in excess of 65 feet have been achieved in unconsolidated, homogeneous sandy soils; attainable depths will be greatly reduced in tighter formations and in soils with gravel and cobbles.

The presence of gravel and cobbles in soils will likely damage soil sampling tubes and possibly probe rods, couplers, stop-pins, and other probing equipment. A sufficient supply of replaceable equipment should be kept onsite in the event of damage or breakdowns. This often requires replacement at the project's—not the subcontractor's—expense. A copy of the Geoprobe Systems Equipment and Tools Catalog should also be kept onsite; Geoprobe Systems provides overnight deliveries.

Prior to conducting the Geoprobe sampling event, underground utilities and structures must be demarcated on the ground surface. The local utility companies must be notified at least 72 hours prior to the scheduled sampling event to allow sufficient time to locate and mark the utility lines. The selected sampling location should be a safe distance from the demarcated utility. In some cases, records regarding utility locations may not exist. In any event, a good practice is to push the probe rods the first few feet, rather than hammering, to ensure that no utilities, underground storage tanks, or other subsurface structures are present.

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GEOPROBE SAMPLING

7.0 REFERENCES

Geoprobe Systems, The Probe-Drive Soil Sampling System, September 1991.

Geoprobe Systems, Equipment and Tools Catalog, 1992.

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Date: April 16, 1996

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the theory and procedures necessary to perform a magnetometer survey.

2.0 BACKGROUND

2.1 Definitions

Diurnal variations - daily changes in the total magnetic field strength; these variations are the effect of solar winds and are typically in the order of 50 gammas, although changes as large as 180 gammas are common.

Gamma - unit of total magnetic field strength (1 gamma = 10^{-5} gauss = 10^{-9} tesla)

Gradient - change in magnetic field strength in a given vertical or horizontal distance.

Magnetic storm - sudden and simultaneous variations of up to several hundred gammas throughout the world. Magnetic storms can occur as often as several times a month and can last one to several days.

Remanent magnetization - residual magnetization possessed by rocks and other materials in situ and in the absence of an applied magnetic field.

Total magnetic field intensity - a scalar measurement of the magnitude of the earth's magnetic field vector independent of its direction.

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2.2 Discussion

Magnetic surveying is a passive geophysical technique that measures the strength of the earth's magnetic field. The earth's magnetic field is a vector quantity having a unique magnitude and direction at every point on the earth's surface. A magnetometer is an instrument that measures the magnetic field strength in units of gammas or nanoteslas. Buried ferrous metal objects, such as pipelines, barrels, and tanks, generally produce a 3-dimensional perturbation in the earth's naturally occurring magnetic field. The size (amplitude) of this perturbation is related to the mass of, distance to, magnetic susceptibility and remanent magnetization of the buried object. Accordingly, the magnetometer may serve as a primary choice for locating the following typical waste site features: bulk waste trenches (assuming ferrous materials are present); buried steel drums; buried pipes and tanks; and abandoned wells with steel casings.

The earth's magnetic field is not completely stable. It undergoes long-term (secular) variations over centuries, as well as small, daily (diurnal) variations (less than 1 percent of the total field magnitude) and transient fluctuations (e.g., magnetic storms) resulting from solar flare phenomena. Both naturally occurring and manmade magnetic materials can locally modify the earth's magnetic field.

Analysis of magnetic data can provide an estimate of the areal extent and quantity of buried ferrous objects. Approximations of depth of burial can be made using graphical methods of interpretation such as slope techniques and half-width rules as described in Nettleton (1976).

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that field personnel have been trained in conducting magnetometer surveys and for ensuring that surveys are conducted in accordance with this procedure.

Project Field Geologist/Geophysicist - The Project Field Geologist/Geophysicist (or appropriately trained field personnel) is responsible for performing magnetometer surveys in accordance with this procedure and for verifying that the data collected are adequate and of high quality.

4.0 REQUIRED EQUIPMENT

Magnetometers commonly used in hazardous waste site investigations include the total field proton precession magnetometer, the fluxgate magnetometer, and the magnetic gradiometer. The total field proton precession magnetometer is the most commonly used magnetometer because it is easy to

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operate, has no instrumental drift, and can acquire data rapidly. The fluxgate magnetometer can better define the boundaries of buried ferrous objects than the proton precession magnetometer, but is subject to instrument drift. Magnetic gradiometer measurements enhance anomalies resulting from shallow magnetic sources. Textbooks such as Telford (et al. 1976) and Nettleton (1976) discuss in detail the operation and construction of these and other magnetometers.

The total field proton precession magnetometer is the most commonly used magnetometer in hazardous waste site investigations. This instrument utilizes the precession of spinning protons of hydrogen atoms in a sample fluid (kerosene, alcohol or water) to measure the total magnetic field intensity. Total field proton precession magnetometers are portable and do not require precise orientation and leveling; however, the sensor must be oriented with one side facing approximately north and the sensor held stationary during the cycling period. Proton precession magnetometers have no instrument drift, do not require calibrations, are easy to operate, and have an accuracy of 0.1 gamma. The most recent proton precession magnetometers have digital readouts and internal temporary storage of data.

The fluxgate magnetometer was developed during World War II as a submarine detector. Standard texts (Telford et al. 1976; Rao and Murthy 1978) explain in detail the principles of operation of the fluxgate magnetometer. The fluxgate magnetometer can define the boundaries of regions of buried ferrous metal objects more precisely than the proton precession magnetometer.

There are several sources of errors in fluxgate magnetometer readings including unbalance in the two coils, thermal and shock noise, circuit drift, and temperature sensitivity. Advantages include direct readout, no azimuth orientation, minimal leveling, light weight, and portability (Telford et al. 1976).

Vertical magnetic gradiometers measure vertical differences in the earth's total magnetic field. Gradient measurements enhance magnetic anomalies resulting from near surface magnetic sources. Discrimination between neighboring magnetic anomalies is also enhanced. These measurements are generally made using an instrument similar to a total field magnetometer that has two or more sensors mounted on a staff. The sensors are vertically separated by a constant distance, usually 1 to 3 feet. Gradient readings are adversely affected by ferrous metal surface debris since signals from this surface debris are also amplified. Consequently, removal of surface metal should be considered before conducting a gradiometer survey.

Additional equipment may be needed, such as:

- a fiberglass tape measure
- a Brunton compass
- a tripod for holding instruments
- wooden stakes

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- plastic flagging
- any personal protective equipment specified in the site-specific health and safety plan

NOTE: No iron or steel materials, including steel-toed boots, respirators, or self-contained breathing apparatus may be worn by the person operating the magnetometer.

5.0 PROCEDURES

Magnetic data are generally acquired at relatively close station spacings (5- to 50-foot intervals) along closely spaced (10- to 50-foot) parallel survey lines.

Magnetic data can be acquired in a rectangular grid pattern or along traverses. Grid data are readings acquired at the nodes of a rectangular grid; traverse data are acquired at fixed intervals along a line. Traverse data are often preferable to grid data because they generally are less expensive to acquire (heavily vegetated sites require time-consuming brush cutting to establish a complete grid) and more useful for interpretation than an equal number of grid readings. Ideally, traverse lines ought to be oriented in a north-south direction so that the maximum amplitude of an anomaly can be detected. However, line orientations are often more dependent on site obstacles and sources of magnetic noise.

Station and line spacing intervals are determined on the basis of the desired resolution of the survey. If individual drums or clusters of deeply (greater than 25 feet) buried drums are the objective of the survey, then a detailed magnetic survey with relatively close station spacings (approximately 5 to 10 feet) and line spacings (approximately 10 to 25 feet) should be used. If large metal objects such as 10,000-gallon tanks or trenches filled with barrels are the objective of the magnetic survey, then a reconnaissance or screening survey with longer station spacings (25, 50, or 100 feet) and line spacings of 25, 50, or 100 feet may be appropriate. In conducting a survey the field operator must avoid or note any sources of high magnetic gradients and alternating currents, such as power lines, buildings, and any large iron or steel objects. It is also important that the operator be relatively free of magnetic materials on his/her person (i.e., watches, glasses) and the magnetometer sensor be kept clean to avoid possible magnetic-bearing dirt. Periodically during a survey, and particularly when an anomaly is detected, it is important to establish that the magnetometer is providing valid readings and not random, meaningless instrument noise. The simplest means of verifying magnetometer field readings is to take several successive readings at one location. These reading should repeat to within ± 1 gamma. (In areas where the magnetic gradient is high, readings may vary ± 10 gammas or more.) Readings are taken at predetermined intervals that depend on the nature of the survey and that may have to be modified depending on the gradients encountered. For a detailed survey, a base station or the reoccupation of a set of stations several times a day or a continuous monitoring station (within 100

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miles) is established to check for diurnal variations and magnetic storms. Magnetic surveying should not be conducted during a magnetic storm due to the large instantaneous changes in the total magnetic field.

The following steps must be followed when conducting magnetometer surveys:

1. Review available information concerning past disposal practices at the site to be surveyed so that target areas and potential sources of interference can be identified. Estimate the intensities of potential anomalies, if possible.
2. Determine the necessary resolution of the survey based on the size of the smallest target.
3. Visit the site to determine the applicability of the method with regard to terrain and possible interferences such as surface metals, fences, buildings, and power lines and other utilities.
4. Review the site geology to determine if there are any variable geologic conditions or geologic features that may produce anomalies and affect detection of the target.
5. Establish a base station for the site to provide data to correct for diurnal variations in the magnetic field and to identify magnetic storms. Note: This step may be omitted if an accurate source of magnetic data is available (e.g., National Oceanographic and Atmospheric Administration stations).
6. Check and record the calibration date on the magnetometer and complete any applicable instrument response or field checks per SOP 5-1. Magnetometers generally are calibrated by the manufacturer. If more than one (1) year has elapsed since the last calibration, return the instrument to the manufacturer for recalibration.
7. Identify an appropriate location at the site that has no documented history of disposal to establish background conditions at the site. Conduct a survey over an area of appropriate size and tabulate the average intensity reading and the range of readings. Establish a baseline value, which is the lowest intensity value that would be considered anomalous. This step will characterize the conductivity and magnetic intensity of subsurface materials at the site and allow accurate delineation of anomalies.
8. Design a survey with data taken at either equally spaced stations located across a rectangular grid or at equal intervals along several profile lines (profile lines need not be parallel). The distance between stations is dependent on the target size, and, as a rule of thumb, the spacing between stations should be approximately one-fourth of the lateral extent of the target. The

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closer the stations are spaced, the better the resolution becomes, thus increasing the probability of detecting magnetic anomalies.

9. Construct the survey grid so that, if possible, the grid lines are perpendicular to the long axis of the target. If not possible, then construct the grid lines north to south.
10. Mark the grid with wooden stakes or some other nonmetallic station marker.
11. Take a measurement at a particular site by placing the magnetometer at a station, properly orienting the sensor, and taking the reading in accordance with the operating instructions for the particular instrument being used.

Hold the magnetometer above ground at least 0.5 meter for this measurement. A greater distance between the ground and the sensor will be necessary in many cases to reduce interferences produced by small ferrous masses at the surface. All subsequent measurements at all grid sites must be taken at this same height above ground.

12. Collect readings of intermediate locations between the established traverses and recording stations to better delineate areas with a high magnetic field gradient.
13. If interferences are unavoidable, be sure to account for their effects and proceed accordingly.
14. Record the reading, survey marks, and comments in an applicable logbook.
15. Note permanent features, with respect to grid locations, to facilitate the preparation of a base map upon which the grid and resultant data can be accurately depicted.
16. Collect the readings in the most compressed time frame possible to reduce diurnal effects on the data.

6.0 POST-SURVEY WORK ACTIVITIES

6.1 Data Interpretation and Presentation

In many cases, the total magnetic field data may require only a simple qualitative analysis in the field. Generally, however, a quantitative analysis is performed with the data presented in the form of a contour map. The contour map is generated by plotting the x, y, and z coordinates of the survey data, where x and y represent a physical location on the grid, and z represents the total field intensity at that

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location. For the purpose of contouring shallow localized targets (i.e., most environmental applications), the removal of regional gradients and diurnal variations will not be necessary. In most cases, the contour interval used for this type of data is significantly larger than either of these phenomena. If desired, the total field readings can be reduced by the average background intensity.

Profiles of specific magnetic anomalies within the survey area can also be generated. These profiles can be used to make gross estimates concerning the depth and mass of the anomaly source.

6.2 Data Entry and Software

Many magnetometers are equipped with built-in data loggers that will store the x, y, and z variables as the survey progresses. The data can then be down-loaded to one of many processing and display programs. This procedure eliminates the necessity of manual data entry. One significant disadvantage of the data logger is that it does usually not allow, in any convenient manner, for the entry of intermediate recording stations that deviate from the preprogrammed grid configuration.

Examples of software packages suitable for the manipulation of magnetic field data include the Golden packages (Surfer and Grapher), Mag-Pac (designed specifically for magnetometers built by EG&G Geometrics), Magmod (by GeoCompu-Graph), and Magix (by Interpex Ltd.). The golden and Mag-Pac packages are suitable for presentation purposes only, while the Magmod and Magix packages contain both presentation and interpretation capabilities.

7.0 RESTRICTIONS/LIMITATIONS

The following limitations apply to this procedure:

1. Natural formations or man-made objects such as buildings may interfere with or invalidate magnetic measurements.
2. Detection is limited to the depth and quantity of ferrous metal present.
3. Data from magnetometer surveys are considered to be screening data and, therefore, meet EPA and HAZWRAP screening requirements only.

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1.0 OBJECTIVE

This standard operating procedure (SOP) governs lithologic logging of core, cuttings, split spoon samples, and subsurface samples collected during field operations at sites where environmental investigations are performed by CDM Federal Programs Corporation (CDM Federal). The purpose of this SOP is to present a set of descriptive protocols and standardized reporting formats to be used by all investigators in making lithologic observations. It prescribes protocols for recording basic lithologic data including, but not limited to, lithologic names, texture, composition, color, sedimentary structures, bedding, lateral and vertical contacts, and secondary features such as fractures and bioturbation.

The goal of this SOP is to provide a set of instructions to produce uniform lithologic descriptions and to present a list of references to help in this task.

2.0 BACKGROUND

2.1 Definitions

The following list of definitions corresponds to the description sequences outlined in Section 5.2.1. They are provided to aid the lithologic logger in what to look for when following the sequences. An example lithologic log is given in Attachment A.

Name of Sediment or Rock - In naming unconsolidated sediments, the logger should use field equipment and reference charts to help identify the grain-size distribution and should name the material according to the procedure in Section 5.2.1. In naming sedimentary, igneous, and metamorphic rocks, the logger should examine the specimen for mineralogy and use the appropriate classification chart in the attachments.

Texture - In examining unconsolidated sediments, the texture shall refer to the grain size distribution, particle angularity, sorting, and packing. The logger should provide estimates of the grain-sizes present using Attachment B and C. When larger particles such as cobbles are present, determine the size of the particles and give a percentage estimate. The sediment particles should be examined for angularity by

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present and the density of voids as well as a size estimation should be given. If fractures or cavities contain evidence of secondary minerals such as zeolites, clays, or iron oxides, then a description of the mineral fill should be added.

Evidence of Contamination - The logger should examine the core and note any obvious signs of contamination such as streaking, free product, odor, or discoloration. These observations should be noted in the field book as should any readings from the photo ionization or flame ionization detector (PID/FID). PID/FID hits should be recorded on the Lithologic Log form also.

Description of Contacts - The logger should note any significant change in lithology. These changes may be gradational contacts within sediments or may be sharp contacts such as sediments over rocks. The contacts should be noted as to whether they are erosional, gradational, or sharp and the depth below the surface should be noted.

Composition - The composition of the rock refers to the mineralogy of the material encountered. For sedimentary rocks, it is important to note the matrix composition and use Attachment E in naming. In igneous and metamorphic rocks, the minerals which make up the rock should be stated and an estimation of their percentage should be noted. The classification charts listed in the Attachments D and F provide a description of common compositions.

Degree of Vittrification - This term is applicable to volcanic rocks and refers to the degree of welding in pyroclastic materials. Describe these rocks as poorly welded, moderately welded, or strongly welded.

2.2 Discussion

The installation of monitoring wells, piezometers, and boreholes is a standard practice at many sites requiring environmental investigations. The installation of these devices requires that a trained geologist, or other earth scientist, provide lithologic descriptions as they encounter subsurface material during augering or drilling. In evaluating these lithologic descriptions from different boreholes, monitoring wells, or piezometers, it is sometimes possible to correlate similar units. To help in this task, it is important to provide uniform and consistent descriptions.

In describing lithologies, it is helpful to have a set of references covering items such as the classification of igneous, metamorphic, and sedimentary rocks, grain-size percentage estimation, particle shape, grain-size charts, and lithologic symbols. In order to make lithologic descriptions produced by CDM Federal staff as uniform and consistent as possible, this SOP provides a list of references to be used in the field. This SOP also provides a sequence for recording information on a standardized log form to make descriptions as uniform and consistent as possible.

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3.0 RESPONSIBILITIES

Geologist - The field person performing lithologic logging is responsible for making a consistent and uniform log and for turning in field forms and logbooks to the Field Team Leader (FTL).

Field Team Leader - The FTL is responsible for maintaining logbooks and forms and for approving techniques of lithologic logging not specifically described in this SOP.

4.0 REQUIRED EQUIPMENT

The description of subsurface lithologies requires a minor amount of field equipment for the geologist. This section provides a list of equipment to be used by the lithologic logger but does not include equipment such as drill rigs, PID/FID, sampling equipment, and personal protection equipment. The following is a general list of equipment that may be used:

- Field logbook and Lithologic Log form
- Clipboard
- Dilute (10%) HCl
- Plastic sheeting
- PVC sampling trays
- Waterproof pens
- No. 2 sieve
- 10x magnifying hand lens
- Reference field charts
- PID/FID

5.0 PROCEDURES

5.1 Office

- Obtain field logbook and Lithologic Log forms
- Coordinate schedules/actions with FTL
- Obtain necessary field equipment (i.e., hand lens, 10% HCl)
- Obtain CDM Federal reference field charts
- Review field support documents (i.e., sampling plan, health and safety plan)

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- Review applicable geologic references such as U.S. Department of Agriculture (USDA) Soil Conservation Survey Soil Surveys and/or geologic maps

5.1.1 Documentation

Individuals performing lithologic logging will record their observations in a commercially available, bound field logbook (e.g., Lietz books) and/or on individual Lithologic Log forms. Lithologic loggers will follow the general procedures for keeping a field logbook. When using a bound field logbook, record the same data required on the Lithologic Log form. Data from the field logbook must be transcribed to the Lithologic Log form if filling in the form in the field is not feasible. However, the data must be the same as that recorded in the field logbook. Editing of field logbook data is not allowed. In addition, if data are transcribed to the Lithologic Log form, it should be done within one day of the original data recording. All blanks in the Lithologic Log form must be filled out. If an item is not applicable, an "NA" should be entered.

The Lithologic Log form should be filled out according to the following instructions:

The top part of the form contains general information. The project name and number must be filled in to identify the site. The date that drilling was started and completed, and the well number within the site should be stated. The name of the person logging the well is recorded as is the total depth drilled. Weather condition descriptions should correlate with what is written in the logbook. The last item to be completed is the name and company of the driller and the type of drill rig and bits used.

The bottom part of the form shall be completed according to the instructions provided within this section and according to the sequence provided in Section 5.2.1. The depth column refers to the depth below ground surface and should be provided in feet. The tick marks can be arbitrarily set to any depth interval depending on the scale needed except where client requirements dictate the spacing. The lithology column should contain a schematic representation of the subsurface according to the symbols found in Attachment G. Use a single X to mark the area where no core was recovered, and notes should be recorded as to why the section was not recovered. The X should be marked from the top to the bottom of the section so that the entire interval is marked. If the geologist can interpret the probable lithology of the missing section with reasonable confidence, they may fill in the symbols behind the X. Sharp or abrupt contacts between lithologies will be indicated by a solid horizontal line. Gradational changes in lithologic composition will be shown by a gradual change of lithologic symbol in the appropriate zone. PID/FID hits should be recorded within the PID/FID column at the appropriate depth, if applicable. Blow counts specifically refer to the number of hammer blows it takes to drive a split spoon into the ground. Usually this is recorded as the number of blows per 6 inches but may vary. The recording of blow counts provides a relative feel for the cohesiveness of the formation. The individual recording lithologic logs should ask the FTL whether it is required information. The description column is the most important part

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of the lithologic log form and is where the lithology is described. In completing this section, use the applicable reference charts and complete according to the sequence in Section 5.2.1. The sample interval column is reserved for noting any samples taken and processed for the laboratory. The sample number shall be filled in at the appropriate depth. The last column refers to the percent core recovery. The individual performing lithologic logging should determine the amount recovered and write the percentage at the appropriate depth.

In addition to the information on the lithologic form, the logger should fill in appropriate information into the logbook when there is a rig shut down, rig problems, failures to recover cores, or other issues.

5.2 General Guidelines for Using and Supplementing Lithologic Descriptive Protocols

This SOP is intended to serve as a guide for recording basic lithologic information with emphasis on those sediment or rock properties that affect groundwater flow and contaminant transport. The fields of specialization of geologists using this SOP will vary. If the user has expertise in a particular field of petrology or soil science that allows for descriptions of certain geologic sections beyond the basic level required by this SOP, they may expand their descriptions. This should be done only with approval of the FTL. The descriptive protocol presented here must be followed in making basic observations. Any further descriptions must follow a protocol that is published and generally recognized by the geologic community as a standard reference. General lithologic description will not include collecting detailed information such as can be obtained from sieve analysis or petrographic analysis. This SOP is a guide for recording visual observations of samples in the field aided by a 10x hand lens and the other simple tools. Field descriptions should be supplemented by petrographic analysis and sieve analysis when the FTL needs data on numerical grain size distributions, secondary porosity development, or other data that can be collected by these methods.

This SOP includes protocols for describing igneous, metamorphic, sedimentary rocks, and unconsolidated materials. Common abbreviations are given in Attachment H. This SOP includes charts to be used for classification and naming of rocks, sediments, and soils, and descriptions of texture, sedimentary structures, and percentage composition of grains. There is also a chart of lithologic symbols to be used and a list of abbreviations. For charts covering other observations or field procedures not specified by this SOP, the user is referred to the following for more information:

- *Compton's Manual of Field Geology* and *American Geological Society (AGI) Data Sheets for Geology in the Field, Laboratory, and Office* contain other reference charts applicable to descriptions. The source of the chart used must be recorded on the Lithologic Log form or in the field logbook.

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- The Munsell soil color chart may be used for descriptions of color.
- The *Dictionary of Geological Terms* (AGI) is to be used for definitions of geological terms.

Some observations will be common to all rock and soil descriptions. All descriptions should include as appropriate: name of sediment or rock, color, sedimentary structures, texture, moisture content, composition, fabric, significant inclusions, and degree of consolidation or induration. The description of each category should be separated by a semicolon. Each section that discusses descriptions of a particular lithology provides a sequence for recording observations. Follow these sequences for all descriptions. All lithologic descriptions shall be segregated from interpretive comments by recording them in the field book.

Secondary features affecting porosity and permeability such as fractures (joints or faults), cavities, and/or bioturbation should be described if observed. Exact measurement of apparent bed thicknesses should be made when logging core and should supplement terminology such as "thin" or "thick." Particular attention is to be given to recording exact locations of water tables, perched saturated zones, and description of contaminants that may be visible. In some cases individuals logging may wish to describe materials such as unconsolidated sediments and soils according to different systems such as the Unified Soil Classification System (USCS) or USDA Soil Taxonomy System. These descriptions can provide additional information from what is required by this SOP. If an individual is competent in using other description methods, then they should do so with permission from the FTL. It is often more practical to use abbreviations for often repeated terminology when recording lithologic descriptions. For the terms given in this SOP, its Attachments, or the associated charts to be used for description in the field, use only the designated abbreviations. Other abbreviations are allowed. However, the abbreviation and its meaning should be recorded on the lithologic log the first time it is used and should be recorded at least once for every well or boring log. Loggers are cautioned to limit the use of abbreviations to avoid producing a lithologic log that is excessively cryptic.

5.2.1 Protocols for Lithologic Description

This section describes the protocols for completing a lithologic description. The logger should use the appropriate portion of this section when describing cores. In recording descriptions of sedimentary sections from a whole core it is possible to reduce the amount of description being written by at least two strategies. One is to look at as long of a section of core as possible, looking for the "big" picture. For instance, in a 20-ft-thick zone the dominant lithology may be siltstone that is interrupted by several thin beds of another lithology such as gravel. This section description can be simplified by writing: 35-55 (below ground surface) bgs = siltstone (with other descriptors) except as noted; 37.5-38.5 gravel zone (with descriptors); 40-42 pebble zone (with descriptors); etc. This also aids in "seeing" the thickest unit designations possible for use in modeling. Another acceptable way to describe the same interval would

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be: 35-37.5 siltstone; 37.5-38.5 gravel zone (with descriptors); 38-40 same as 35-37.5; 40-42 pebble zone (with descriptors); etc.

Description of Unconsolidated Material

Unconsolidated material comprises a significant portion of the sections of interest at CDM Federal sites. The shallow subsurface is very important to the hydrologic investigation, as this is the portion of the geologic section where infiltration first occurs. Much of the contamination at sites being investigated is surface contamination and therefore lies on, or within, the upper portion of the surficial material.

For the purpose of this SOP, soil refers to the upper biochemically weathered portion of the regolith and not the entire regolith itself. Soils are to be described as unconsolidated material and should use the same description format. The scientist may use the USCS classification if consistent with project objectives. More detailed soil descriptions should only be made in addition to descriptions outlined in Section 3.3.3.

Descriptions of unconsolidated sediments should follow the following sequence:

Name of sediment (sand, silt, clay, etc.)

- Texture
- Composition of larger-grained sediments
- Color
- Structure
- Degree of consolidation and cementation
- Moisture content
- Evidence of bioturbation
- Description of contacts

In naming unconsolidated material (refer to Naming of Unconsolidated Materials, Attachment I), the particle size with the highest percentage is the root name. When additional grains are present in excess of 15%, the root name is modified by adding a term in front of the root name. For instance, if a material is 80% sand and 20% gravel, then it is gravelly sand. If the subordinate grains comprise less than 15% but greater than 5%, the name is written: _____ (dominant grain) with _____ (subordinate grain). For example, a sediment with 90% sand and 10% silt would be named a sand with silt. If a sediment contains greater than 15% of four particle sizes, then the name is comprised of the dominant grain size as the root name and modifiers as added before. For example, if a material is 60% sand, 20% silt and 20% clay the name would be a silty clayey sand. If a material is 70% sand, 20% silt and 10% clay, it would be a silty sand with clay. When large cobbles or boulders are present, their percentage should be estimated and their mineralogy recorded. Use AGI Data Sheet 29.1 (Attachment B) for grain terms. Refer to Attachment J for an example sorting chart.

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Description of Sedimentary Rocks

Sedimentary rocks consist of lithified detrital sediments such as sand and clay, chemically precipitated sediments such as limestone and gypsum, and biogenic material such as coal and coquina. The classification scheme for naming these rocks is found in Attachment E, Classification of Sedimentary Rocks.

Descriptors for sedimentary rocks should be given in the lithologic log in the following sequence:

- Name of rock
- Texture
- Color
- Sedimentary structures
- Degree of composition
- Presence of fractures or vugs
- Moisture content
- Bioturbation
- Description of contacts

Description of Igneous and Metamorphic Rocks

Igneous rocks, volcanic and plutonic, and metamorphic rocks are not as commonly observed at work sites, but they may be found interspersed in the sedimentary section as ash layers and as bedrock. Where they form bedrock, the development of fractures and vugs is important to their hydrologic properties. If the logger is unsure of the name of the rock because of difficulty in determining mineralogy, the name shall be accompanied by a question mark. Attachments E and F provide a classification system for these materials.

Igneous and metamorphic rock descriptions should follow the general format:

- Name of rock
- Texture
- Color
- Degree of induration for volcaniclastics
- Composition
- Presence of fractures or vugs
- Presence of secondary mineralization

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- Moisture content
- Weathering

6.0 RESTRICTIONS/LIMITATIONS

Only geologists, or similarly qualified persons trained in lithologic description are qualified to perform the duties described in this SOP. The FTL for a project will have the authority to decide whether or not an individual is qualified.

7.0 REFERENCES

American Geological Society, *American Geological Society Data Sheets for Geology in the Field, Laboratory, and Office*, 3rd Ed, 1989.

American Geological Society, *Dictionary of Geologic Terms*, Anchor Press, Garden City, New York, 1960.

Compton, R.R., *Manual of Field Geology*, John Wiley & Sons Inc., New York, New York, 1962.

Munsell Color Chart, Soil Test Inc., Evanston, Illinois, 1975.

U.S. Department of Agriculture Soil Conservation Service, *Soil Taxonomy*, U.S. Government Printing Office, Washington, D.C., 1972.

Woodward, L.A., *Laboratory Manual Physical Geology*, University of New Mexico Printing, Albuquerque, New Mexico, 1988.

8.0 ATTACHMENTS

Note: These Attachments are for informational purposes. Other equivalent charts such as USCS or logs may be used.

Attachment A - CDM Federal Programs Corporation Lithologic Log

Attachment B - Grain-size Scale, Graph determining size of sedimentary particles, particle degree of roundness charts.

Attachment C - Particle degree of Distribution Estimation Chart

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- Attachment D - Classification of Igneous Rocks
- Attachment E - Classification of Sedimentary Rocks
- Attachment F - Classification of Metamorphic Rocks
- Attachment G - Lithologic Symbol Chart
- Attachment H - Abbreviations
- Attachment I - Naming of Unconsolidated Materials
- Attachment J - Sorting Chart
- Attachment K - Example of United Soil Classification System (USCS)

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ATTACHMENT A

[illegible]

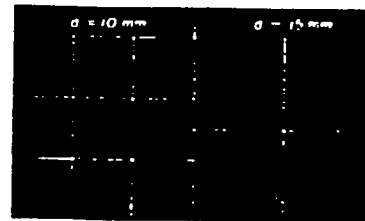
Page: 13 of 23

AQI DATA SHEET 20.1

Modified Wentworth Scale — after Lane, et al., 1947. Trans. American Geophysical Union, v. 28, p. 625-635

AOI DATA SHEET 20.2

LIGHT PARTICLES



Reprints (1) Group V Change 1984. Some discussion of community activities and
 very brief group AAFG but + as in 1 of 174 (2) B. J. Brown 1984. Photographs of
 community work, 2nd ed., 257 p. Georgetown, Guyana-London

Very angular Angular Sub-angular Sub-rounded Rounded Well rounded

Technical Standard Operating Procedures

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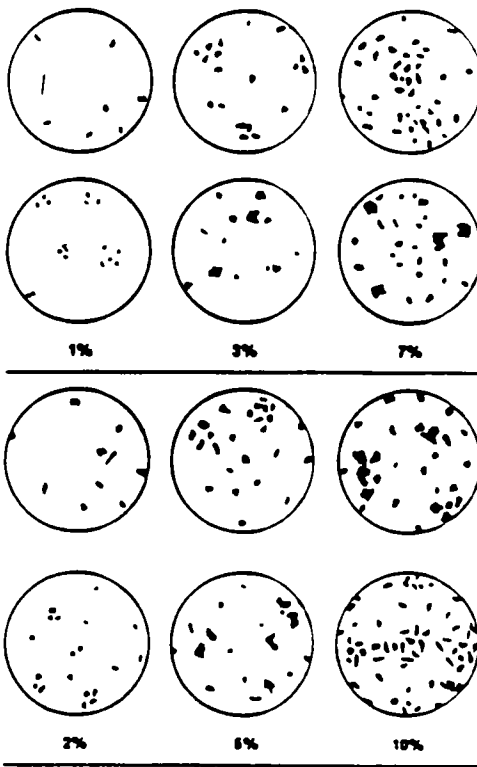
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ATTACHMENT C

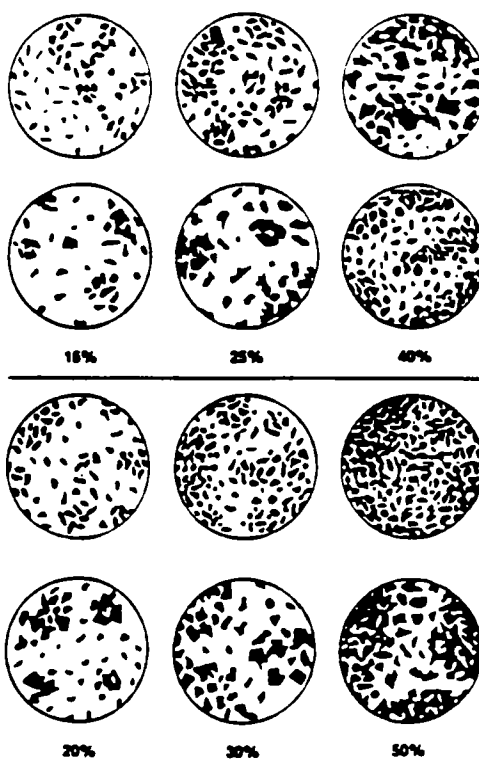
AGI DATA SHEET 23.1

Comparison Chart for Estimating Percentage Composition

Prepared by Richard B. Terry and George V. Chelmer, Allen Petroleum Foundation, Los Angeles. Reprinted from *Journal of Sedimentary Petrology*, v. 25, p. 3, p. 228-234, Sept. 1955.



AGI DATA SHEET 23.2



American Geological Institute, Data Sheets, Third Edition, 1989.

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ATTACHMENT D

CLASSIFICATION OF IGNEOUS ROCKS					
MINERAL COMPOSITION					
		Quartz > 10% Abundant feldspar Mafic minerals minor	Quartz < 10% Abundant feldspar Mafic minerals moderate	Feldspar abundant Mafic minerals 40-70 %; Quartz minor or absent	Mafic minerals > 70%
Color Index		Light Color	Intermediate color	Dark	Dark
Chemistry		SiO ₂ 70%	SiO ₂ 60%	SiO ₂ 50%	SiO ₂ 40%
TEXTURE	Phenocryst (visible with naked eye)	Granite (Gr)	Diorite (Di)	Gabbro (Gb)	Peridotite (Pr) (mostly olivine)
	Aphanitic (macroscopic)	Rhyolite (Ry) (quartz phenocrysts)	Andesite (An) (feldspar or mafic phenocrysts; no quartz)	Basalt (Ba)	Komatiite (Km) (very rare)
		Felsite (Fi) (no phenocrysts)			
	Glassy	Obsidian (ob) Pumice (Pu)		Rare	
	Glassy-Fragmental (Pyroclastic)	Tuff < 4mm (Tf) Breccia > 4mm (Br)		Rare	

* Modified from Woodward, L.A., Laboratory Manual Physical Geology, 1988.

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ATTACHMENT E

CLASSIFICATION OF SEDIMENTARY ROCKS		
	COMPOSITION AND/OR GRAIN SIZE	NAME OF ROCK
D E T R I T A L	Gravel greater than 2 mm	CONGLOMERATE (Cg)
		BRECCIA (Br)
	Sand 2 mm to 1/16 mm	SANDSTONE (Sa)
		QUARTZ (Qtz) GRAYWACKE (Grw) ARKOSE (Ak)
	Mud less than 1/16 mm	SHALE (Sh)
		SILTSTONE (Sl)
		MUDSTONE (Ms)
C H E M I C A L	Limy mud or oolites	LIMESTONE (Ls)
		TRAVERTINE (Tvt)
		DOLOMITE (Dl)
	Silica	CHERT (Ch)
	Calcium Sulphate plus water	GYP SUM (Gy)
B I O G E N I C	Halite	ROCKSALT (Ns)
	Plant remains	COAL (Ct)
	Shell fragments, shells, fragments; some limy mud usually present	COQUINA (Cq)
		CHALK (Chk)
	Shells of diatoms (marine or freshwater algae)	DIATOMITE (Dm)

* Modified from Woodward, L.A., Laboratory Manual
Physical Geology, 1988.

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ATTACHMENT F

CLASSIFICATION OF METAMORPHIC ROCKS			
STRUCTURE	TEXTURE	CHIEF MINERALS	NAME
Non-foliated	granular; bands across grains	quartz	Quartzite (Qtz)
	granular; grain clearly visible	calcite	Marble (Mbl)
	granular; grain altered and distinct	plagioclase, chlorite, epidote, hornblende	Gneiss (Gne)
	very fine-grained	microcrystalline, mostly submicroscopic matrix and clasts	Hornfels (Hnf)
Foliated	slaty	schistose, quartz	Slate (Sl)
	phyllitic	microscopic, quartz	Phyllite (Phl)
	schistose	microscopic, quartz, amphibole	Blaschke
		chlorite, mica, plagioclase	Chlorite Schist (Cl-Sch)
		monzonite, quartz	Monzonite (Ma) Schist (Sch)
		granite, monzonite	Granite (G) Monzonite (Ma) Schist (Sch)
		hornblende, plagioclase	Amphibolite (Amp)
		monzonite, granite, monzonite	Granite (G) Monzonite (Ma) Schist (Sch)
		plagioclase, hornblende	Amphibolite (Amp) Gneiss (Gne)
	granular	feldspar, quartz	Granite (Gr) Gneiss (Gne)
		eye-shaped feldspar, mica	Amphibolite (Amp) Gneiss (Gne)

* Modified from Wentworth, L.A., Laboratory Manual Physical Geology, 1988.

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ATTACHMENT G

Symbols for Sedimentary Rocks	Symbols for Metamorphic Rocks	Symbols for Igneous Rocks	Symbols for Grains	Symbols for Bedding

Compton, R.R., Manual of Field Geology, 1962.

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ATTACHMENT H

COMMON ABBREVIATIONS		
Abundant - abn	Diameter - dia	Laminated - lam
Amount - am	Different - diff	Maximum - max
Approximate - approx	Disseminated - dissem	Pebble - pbl
Arenaceous - are	Elevation - elev	Phenocryst - phen
Argillaceous - arg	Equivalent - equiv	Porphyritic - porph
Average - ave	Foliated - fol	Probable - prob
Bedded - bdd	Formation - frm	Quartz - qtz
Bedding - bdg	Fracture - frac	Regular - reg
Calcareous - calc	Fragmental - frag	Rock - rx
Common - com	Granular - Gran	Rounded - rod
Cobble - cbl	Gypsiferous - Gyp	Saturated - sat
Contact - ctc	Horizontal - hrx	Secondary - sec
Cross-bedded - xbdd	Igneous - ign	Siliceous - sil
Cross-bedding - xbdg	Inclusion - incl	Structure - struc
Cross-laminated - xlam	Interbedded - intbed	Unconformity - unconf
Crystal - xl	Irregular - irreg	Variogated - vrgt
Crystalline - xln	Joint - jnt	Vein - vn
<u>Grain Size</u>	<u>Contact</u>	<u>Sorting</u>
grain - ga	gradational - grad	poor - pr
fine - f	erosional - er	moderate - mod
very fine - vf	abrupt - ab	well - well
medium - med		
coarse - co	<u>Fabric</u>	
large - lg	grain supported - gs	
very large - vlg	matrix supported - ms	
small - sm	imbricate - im	

Adapted from: Compton, R.R., Manual of Field Geology, 1962.

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ATTACHMENT I

Naming of Unconsolidated Materials

Mass Percent	Gravel	Sand	Silt	Clay
> 15% gravel	Gravel	Generally Sand	Generally Silt	Generally Clay
> 15% sand	Sandy Gravel	Sand	Sandy Silt	Sandy Clay
> 15% silt	Silty Gravel	Silty Sand	Silt	Silty Clay
> 15% clay	Clayey Gravel	Clayey Sand	Clayey Silt	Clay
5-15% gravel	Not Applicable	Sand with Gravel	Silt with Gravel	Clay with Gravel
5-15% sand	Gravel with sand	Not applicable	Silt with Sand	Clay with sand
5-15% silt	Gravel with silt	Sand with silt	Not applicable	Clay with silt
5-15% clay	Gravel with clay	Sand with clay	Silt with clay	Not applicable
> 15% gravel plus > 15% sand	Sandy Gravel	Generally Sand	Generally Sandy Silt	Generally Sandy Clay
> 15% gravel plus > 15% silt	Silty Gravel	Generally Silty Sand	Generally silt	Generally Silty Clay
> 15% gravel plus > 15% clay	Clayey Gravel	Generally Clayey Sand	Generally Sandy Silt	Generally Clay
> 15% sand plus > 15% silt	Silty Sand Gravel	Silty Sand	Sandy Silt	Sandy Silty Clay
> 15% sand plus > 15% clay	Sandy Clayey Gravel	Clayey Sand	Sandy Clayey Silt	Sandy Clay
> 15% silt plus > 15% clay	Silty Clayey Gravel	Silty Clayey Sand	Clayey Silt	Silty Clay

NOTE: Other combinations are possible when all particles more are present in greater than 15%. For example, a Silty Clayey Gravelly Sand. Other possible combinations must such as a Gravelly Sand with silt.

Compton, R.R., Manual of Field Geology, 1962.

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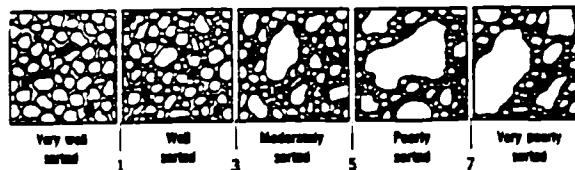
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ATTACHMENT J

Sorting Chart



Compton, R.R., Manual of Field Geology, 1962.

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ATTACHMENT K

Example of Unified Soil Classification System (USCS)

Unified Soil Classification System (USCS)			
	MILLIMETERS	INCHES	SIEVE SIZES
BOULDERS	> 300	> 11.8	-
COBBLES	75 - 300	2.9 - 11.8	-
GRAVEL:			
COARSE	75 - 19	2.9 - .75	-
FINE	19 - 4.8	.75 - .19	3/4" - No. 4
SAND:			
COARSE	4.8 - 2.0	.19 - .08	No. 4 - No. 10
MEDIUM	2.0 - .43	.08 - .02	No. 10 - No. 40
FINE	.43 - .08	.02 - .003	No. 40 - No. 200
FINES:			
SILTS	< .08	< .003	< No. 200
CLAYS	< .08	< .003	< No. 200



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ATTACHMENT K

Example of Unified Soil Classification System (USCS) (Continued)

CLAY

CLAY CONSISTENCY	THUMB PENETRATION	SPT, N BLOWS/ FT.	Undrained Shear Strength c (PSF)	Unconfined Compressive Strength q _c
			TORVANE	Foster Penetrometer
VERY SOFT	Easily penetrated several inches by thumb. Exudes between thumb and fingers when squeezed in hand.	< 2	250	500
SOFT	Easily penetrated one inch by thumb. Molded by light finger pressure.	2 - 4	250 - 500	500 - 1000
MEDIUM STIFF	Can be penetrated over 1/4" by thumb with moderate effort. Molded by strong finger pressure.	4 - 6	500 - 1000	1000 - 2000
STIFF	Indented about 1/4" by thumb but penetrated only with great effort.	8 - 15	1000 - 2000	2000 - 4000
VERY STIFF	Readily indented by thumbnail.	15 - 30	2000 - 4000	4000 - 8000
HARD	Indented with difficulty by thumbnail.	> 30	> 4000	> 8000

SAND

SOIL TYPE	SPT, N Blows/ft	Relative Density %	FIELD TEST
VERY LOOSE SAND	4	0 - 15	Easily penetrated with 1/2" reinforcing rod pushed by hand.
LOOSE SAND	4 - 10	15 - 35	Easily penetrated with 1/2" reinforcing rod pushed by hand.
MEDIUM DENSE SAND	10 - 30	35 - 65	Penetrated a foot with 1/2" reinforcing rod driven with S-B hammer.
DENSE SAND	30 - 50	65 - 85	Penetrated a foot with 1/2" reinforcing rod driven with S-B hammer.
VERY DENSE SAND	50	85 - 100	Penetrated only a few inches with 1/2" reinforcing rod driven with S-B hammer.

FIELD LOGBOOK CONTENT AND CONTROL

SOP 4-1

Revision: 3

Date: February 18, 1999

Page 1 of 5

Prepared: Del Baird

Technical Review: Jackie Mosher

QA Review: David O. Johnson

Approved: [Signature] 2/23/99
Signature/Date

Issued: Rosemary Gustin 2/24/99
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to set CDM Federal criteria for content entry and form of field logbooks.

2.0 BACKGROUND

2.1 Definitions

Biota - The flora and fauna of a region.

Decontamination - To remove contaminants from field sampling equipment that might bias analytical results.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks include observations, data, calculations, time, weather, description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 RESPONSIBILITIES

Field Team Leader (FTL) - The FTL is responsible for ensuring the nature and form of data entries are conducted in accordance with this procedure.

Site Personnel - All CDM Federal employees who make entries in field logbooks during on-site activities are required to read this procedure prior to engaging in this activity. The FTL will assign field logbooks to

FIELD LOGBOOK CONTENT AND CONTROL

SOP 4-1

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site personnel who will be responsible for their care and maintenance.

4.0 REQUIRED EQUIPMENT

- Site-specific plans
- Field notebook
- Indelible black or blue ink pen
- Ruler or similar scale (in some circumstances)

5.0 PROCEDURES

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with other pertinent CDM Federal and site SOPs. These should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. Prior to use in the field, each logbook will be marked with a specific document control number issued by the document control administrator, if required by the QIP. Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

- Field Logbook Document Control Number
- Activity (if the logbook is to be activity-specific)
- Name of CDM Federal contact and phone number(s)
- Start date

The first few (approximately five) pages of the logbook will be reserved for a table of contents. Mark the first page with the heading and enter the following:

TABLE OF CONTENTS

Date/Description

Page

(Start Date)/Reserved for TOC

1-5

FIELD LOGBOOK CONTENT AND CONTROL

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The remaining pages of the Table of Contents will be designated as such with "TOC" written on the top center of each page.

5.2 Operation

The following is a list of requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.
- Record as much information as possible.

Specific requirements for field logbook entries include:

- Initial and date each page
- Sign and date the final page of entries for each day
- Initial and date all changes
- Multiple authors must sign out the logbook by inserting the following:

Above notes authored by:

- (Sign name)
- (Print name)
- (Date)

- A new author must sign and print his/her name before additional entries are made
- Draw a diagonal line through the remainder of the final page at the end of the day
- Record the following information on a daily basis:

- Date and time
- Name of individual making entry

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- Names of field team and other persons on-site
- Description of activity being conducted including station (i.e., well, boring, sampling location number) if appropriate
- Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
- Level of personal protection to be used
- Serial numbers of instruments
- Required calibration information
- Serial/tracking numbers on documentation (e.g., carrier airbills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays
- Upgrade or downgrade of personal protection equipment

5.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the office.

FIELD LOGBOOK CONTENT AND CONTROL

SOP 4-1

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At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 RESTRICTIONS/LIMITATIONS

Field logbooks constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM Federal personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks should be factual, clear, precise, and as non-subjective as possible. Field logbooks, and entries within, are not to be utilized for personal use.

7.0 REFERENCES

Sandia National Laboratories, *Procedure for Preparing, Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures*, QA-02-03, Albuquerque Environmental Program Department 3220, Albuquerque, New Mexico, 1991.

Sandia National Laboratories, Division 7723, *Field Operation Procedure for Field Logbook Content and Control*, Environmental Restoration Department, Albuquerque, New Mexico, 1992.

PHOTOGRAPHIC DOCUMENTATION OF FIELD ACTIVITIES

SOP 4-2

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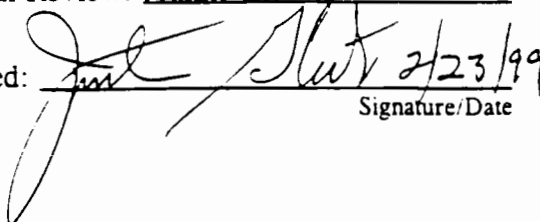
Date: February 18, 1999

Page 1 of 9

Prepared: Del R. Baird

Technical Review: Jeanne Litwin

QA Review: David O. Johnson

Approved:  2/23/99
Signature/Date

Issued: Rosemary Gustin 2/24/99
Signature/Date

1.0 OBJECTIVE

The purpose of this standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include still photography and video tape recordings, of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This document shall provide guidelines designed for use by a professional or amateur photographer. This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 BACKGROUND

2.1 Definitions

Photographer - Camera operator (professional or amateur) of either still photography or video tape recording whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component - Visual components used within a photograph such as visual slates, reference markers, pointers.

Standard Reference Marker - A reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates - Blank, white, index cards used to write information pertaining to the subject/procedure being photographed. Letters and numbers on the slate will be bold and written with black, indelible marking pens.

PHOTOGRAPHIC DOCUMENTATION OF FIELD ACTIVITIES

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Arrows and Pointers - A marker used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds - Backdrop used to lay soil samples, borings, or other objects for clearer viewing and to delineate features.

Data Recording Camera Back - A camera attachment or built-in feature that will record, at the very least, frame numbers and dates directly on the film.

2.2 Discussion

Photographs and video tape recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used and possible lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard reference markers, and pointers. These items shall become an integral part of the "visual media" that, for the purpose of this document, shall encompass both still photographs including digital photographs and video tape recordings (or video footage). The use of a photographic logbook and standardized entry procedures are outlined as well. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the visual media and ensures the representative nature of the photographic documentation.

3.0 RESPONSIBILITIES

Field Team Leader (FTL) - The FTL is responsible for ensuring that the nature and form of data entries are conducted in accordance with this procedure.

Photographer - The photographer shall seek direction from the FTL and discuss the visual documentation requirements and schedule, regularly. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP.

4.0 REQUIRED EQUIPMENT

- 35mm camera or disposable single use camera (35mm or panoramic use)
- Digital Camera
- Video Camera

PHOTOGRAPHIC DOCUMENTATION OF FIELD ACTIVITIES

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- Logbook
- Indelible black ink pen
- Standard reference markers
- Slates
- Arrows or pointers
- Contrasting backgrounds
- Medium speed, or multi purpose fine-grain, color, 35-mm, negative film or slide film (project dependent)
- Data recording camera back (if available)
- Storage disk for digital camera

5.0 PROCEDURES

5.1 Documentation

A commercially available, bound logbook will be used to log and document photographic activities. Review the CDM Federal SOP 4-1 Field Logbook Content and Control and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook or site safety logbook may be designated as the photographic log section.

5.1.1 Field - Health and Safety Considerations

There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site specific and dictated through requirements set by the Site Safety Officer, site Health and Safety Plan, and/or prescribed by the CDM Federal Corporate Health and Safety Program. The photographer should contact the Site Safety Officer for health and safety orientation prior to commencing field activities. The Site Health and Safety Plan must be read prior to entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazardous while photographing the subject (i.e., low overhead hazard, edge of excavation).

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5.2 OPERATION

5.2.1 General Photographic Activities in the Field

The following sections (5.2.1 - 5.3.2) provide general guidelines that should be followed to visually document field activities and site features using still cameras and video equipment. The photographer shall seek direction from the FTL and discuss the visual documentation requirements and schedule, regularly. The FTL is responsible for directing the photographer to specific situations, site features, or operations which the photographer will be responsible for documenting. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

- The photographer should be prepared to make a variety of shots, from close-up to wide angle. Many shots will be repetitive in nature or format especially close-up site feature photographs. Consideration should therefore be given to designing a system or technique that will provide a reliable repetition of performance.
- All still photographs should be made using a medium speed, or multi purpose fine-grain, color negative film in the 35-mm format unless otherwise directed by the FTL.
- It is suggested that Kodak brand "Ektapress Gold Deluxe" film or equivalent be used as the standard film for the still photography requirements of the field activities. This film is stable at room temperature after exposure and will better survive the time lag between exposure and processing. It is suggested that film speed ASA 100 should be used for outdoor photographs in bright sunlight, ASA 200 film should be used in cloudy conditions, and ASA 400 film should be used indoors or for very low-light outdoor photographs.
- No preference of video tape brand is specified, and is left to the discretion of the photographer.
- The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. If the ambient lighting conditions are inadequate, the photographer should be prepared to augment the light (perhaps with reflectors or electronic flash) to maintain the desired visual effect.
- Digital photography quality is determined by the camera. A camera that obtains a higher resolution has a higher number of pixels, and will store a fewer number of photographs per each disk.

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5.2.2 General Guidelines for Still Photography

Each new roll of film, digital storage disk and video tape shall contain upon the first usable frame (for film) or at the beginning of the tape (for video), a slate with the following information:

- A consecutively assigned control number (a consecutive, unique number that is assigned by the photographer to each roll of film or video tape, such as in sample numbers)
- The site location
- FTL's name
- Photographer's name
- Date

Caption Information

All still photographs will have a full caption permanently attached to the back containing the following information:

- Film roll control number and photograph document control number
- A brief site or scene description (What, Where, Who, Why)
- Date
- Time
- Direction
- Photographed by
- Witnessed by (if applicable)

A standard reference marker should be used in all documentary visual media. While the standard reference marker will predominantly be used in close-up feature documentation, inclusion in all scenes should be considered.

Close-up and Feature Photography

All close-up photographs will include a standard reference marker of appropriate size as an indication of the feature size and should contain a slate marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their *in situ* locations. This enables a more accurate record of their

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initial condition and color. Include a standard reference color strip (color chart such as Munsell Soil Color Chart or that available from Eastman Kodak Co.) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aide to the viewer for lithologic observations and interpretations.

The photographer will permanently attach a caption containing pertinent information to the photograph after it has been produced and prior to submitting it to the project files.

Site Photography

Site photography, in general, will consist predominantly of medium and wide angle shots. A standard reference marker should be placed adjacent to the feature, or when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and caption/slate be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide angle shots. In such a case, the film/tape control number shall be entered in the photographic logbook along with the frame number and all other information pertinent to the scene.

The photographer will permanently attach a caption containing this information to the photograph after it has been produced and prior to submitting it to the project files.

Panoramic

In situations where a wide angle lens does not provide sufficient subject detail, a single-use disposal panoramic camera is recommended. If this type of camera is not available, a panoramic series of two or three photos would be appropriate. Panoramics can provide greater detail while covering a wide subject, such as an overall shot of a site.

To shoot a panoramic series using a standard 35mm camera, the following procedure is recommended.

- Utilizing a stable surface or tripod to support the camera is recommended.
- 20 - 30% from overlap while maintaining a uniform horizon is suggested.
- 2 to 3 photos per series is recommended.

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5.2.3 General Photographic Documentation Using Video Cameras

As a reminder, it is not within the scope of this document to set guidelines for presentation or "show" video tape recording. The following guidelines are set for documentary video tape recordings only and should be implemented at the discretion of the FTL.

All documentary video tape recordings of field activities shall include an audio slate for all scenes. At the beginning of each video session an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account should include any additional information clarifying the subject matter being recorded.

A standard reference marker should be used when taking close-up shots of site features with a video camera. The scene should also include a caption/slate. It shall be placed adjacent and parallel to the feature being photographed.

It is strongly encouraged that a standard reference marker and caption/slate be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original video tape recordings will not be edited. This will maintain the integrity of the information contained on the video tape. If editing is desired, a working copy of the original video tape recording can be made. The original video tape will be archived in accordance with Section 5.3.2.

5.2.4 Photographic Documentation

Photographic activities must be documented in a photographic logbook or in a section of the field logbook or site safety logbook. Each logbook will be assigned a document control number. The photographer will be responsible for making proper entries.

In addition to following the technical standards for logbook entry as referenced in Section 5.1.2, the following information should be maintained in the appropriate logbook:

- An entry shall be made for each new roll/tape control number assigned. Include information that is recorded on the film/tape control slate (the site location, FTL's name, photographer name, and date).
- A description of the general setup, including approximate distance between the camera and the subject, will be recorded in the appropriate logbook. Include pertinent information that is

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necessary to provide a complete and full caption for each scene (refer to Sections 5.2.2 and 5.2.3).

- The laboratory used for photographic processing will be recorded (if known) in the appropriate logbook. Record the time and date that film is submitted to the photographic laboratory, as well as the time and date that the negatives and prints are received from the photographic laboratory.
- Document all situations encountered that cause an interruption in the progress of photographic activities under this SOP.
- Record as much other information as possible to assist in the identification of the photographic document.

5.3 Post Operation

All film will be sent for development and printing to a predetermined photographic laboratory (to be determined by the photographer). The photographer will be responsible for arranging transport of the film from the field to the photographic laboratory. The photographer shall also be responsible for delivery of the negatives and photographs or video tape to the project management.

5.3.1 Documentation

At the end of each day's photographic session, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in CDM Federal SOP 4-1.

5.3.2 Archive Procedures

1. All rolls of film, video tape recordings, and photographs should be considered controlled documents. Therefore, all photographs and the associated set of negatives and original unedited documentary video tape recordings will be submitted to the project files and handled accordingly. The FTL will ensure their proper distribution.
2. Based on specific project requirements, the photographer will assign each roll of film or photograph a control number. Film control numbers may be photographed on the first usable frame of the film and permanently attached to the negative sleeve/holders. Control numbers for photographs may contain the control number of the film and the frame number from which the photograph was made and be written on the back of the photograph. All control numbers will be written with black indelible ink.

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3. Original video tape footage shall be assigned a document control number. Video tapes must have a document control number written on the tape case as well as the video tape cassette. All document control numbers will be written with black indelible ink. Original video footage shall not be edited but may be copied.
4. Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

6.0 RESTRICTIONS/LIMITATIONS

This document is designed to provide a set of guidelines for the field amateur or professional photographer to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or "show" photography.

The procedures outlined herein are general by nature. The FTL is responsible for directly specific operational activity or procedure. Questions concerning specific procedures or requirements should be directed to the FTL.

7.0 REFERENCES

Sandia National Laboratories, *Procedure for Preparing Sampling and Analysis Plans, Site-Specific Sampling Plans, and Field Operating Procedures*, QA-02-03, Environmental Programs Department 3220, Albuquerque, New Mexico, 1991.

Sandia National Laboratories, Division 7723, *Field Operating Procedure for Field Logbook Content and Control*, PRO 92-04, Environmental Restoration Department, Albuquerque, New Mexico, 1992.

U.S. Department of Energy, Yucca Mountain Project, *Branch Technical Procedure: Field Logging, Handling, and Documenting Borehole Samples*, Las Vegas, Nevada, 1989.

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4.0 REQUIRED EQUIPMENT

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Laboratory-grade detergent (low phosphate)
- Nalgene or Teflon Sprayers or wash bottles or 2- to 5-gallon. manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Disposable wipes or rags
- Potable water and/or deionized water and/or American Society for Testing and Materials (ASTM) Type II or better, as defined by ASTM Standard Specification for Reagent Water, Standard D 1193-77 (re-approved 1983)*
- Gloves, safety glasses, and other protective clothing as specified in the site-specific health and safety plan
- High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)
- Appropriate decontamination solutions pesticide grade or better and traceable to a source (e.g. 10% and/or 1% nitric acid (HNO_3), acetone, methanol, isopropanol, hexane)
- Tools for equipment assembly and disassembly (as required)
- 55-gallon drums or tanks (as required)
- Pallets for drums or tanks holding decontamination water (as required)

* Potable, deionized, and ASTM Type II water may be required to be tested for contaminants before use. Check field plan for requirements.

5.0 PROCEDURES

All reusable equipment (non-dedicated) used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. Decontamination of equipment will occur either at the central decontamination station or at portable decontamination stations set up at the sampling location, drill sites, or monitoring well locations. The centrally located decontamination station will include an appropriately sized bermed area on which equipment decontamination will occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e., pre-remedial sampling).

The decontamination area will be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the decontamination area which then drains into a collection system. Water from the collection system will be pumped into 55-gallon drums or portable tanks for storage. Typically, decontamination water will be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition

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1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the procedures required for decontamination of field equipment.

2.0 BACKGROUND

2.1 Definitions

Clean - Free of visible contamination and when decontamination has been completed in accordance with this SOP.

Cross-Contamination - The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or noncontaminated samples or areas.

Decontamination - The process of rinsing or otherwise cleaning the surfaces of equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure of personnel.

2.2 Discussion

Decontamination of field equipment is necessary to ensure the quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants off-site.

3.0 RESPONSIBILITIES

Field Team Leader - The Field Team Leader (FTL) ensures that field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this procedure. The FTL may also be required to collect and document rinsate samples to provide quantitative verification that these procedures have been correctly implemented.

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ground surface and berms. All decontamination pads should be upwind of the area to investigated.

2. With the rig in place, spray areas (rear of rig or backhoe) exposed to contaminated soils using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.
3. Use brushes, and low phosphate detergent and potable water to remove dirt whenever necessary.
4. Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.
5. Record equipment type, date, time, and method of decontamination in the appropriate logbook.
6. After decontamination activities are completed, collect all contaminated waste water, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination

Downhole equipment decontamination includes hollow-stem augers, drill pipes, casings, screens, etc. Follow these steps when decontaminating this equipment:

1. Set up a centralized decontamination area, if possible. This area should be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.
2. Set up a "clean" area upwind of the decontamination area to receive cleaned equipment for air drying. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads should be upwind of any areas under investigation.
3. Place the object to be cleaned on aluminum foil or plastic-covered wooden sawhorses or other supports.
4. Using low phosphate detergent and potable water in the hot water high-pressure sprayer (or steam unit), spray the contaminated equipment. Aim downward to avoid spraying outside the decontamination area. Be sure to spray inside corners and gaps especially well. Use a brush, if necessary, to dislodge dirt.

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of the waste is determined. The exact procedure for decontamination waste disposal should be discussed in the field plan. Also, decontamination fluids, such as solvents may need to be segregated from other investigation derived wastes.

All items that will come into contact with potentially contaminated media will be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they will be covered either with plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows:

General Guidelines

- Potable and deionized water should be free of all contaminants of concern. Following the field plan, analytical data from the water source may be required. If required, either existing analytical data from the water source supplier (i.e., municipality, bottled water company, deionized water producer) may be obtained or chemical testing may be performed on the selected source.
- Soap used in the soap and water rinse step will be a low phosphate detergent.
- Sampling equipment that has come into contact with oil and grease will be cleaned with methanol or other approved alternative to remove the oily material. This may be followed by a hexane rinse and then another methanol rinse. Regulatory or client requirements will be stated in the field plan.
- Decontaminated equipment will be allowed to air dry before being used.
- Documentation for all cleaning will be recorded in the appropriate logbook.
- All solvents will be pesticide grade or better and traceable to a source. The corresponding lot numbers will be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment will be used as specified in the site-specific health and safety plan.

5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs and backhoes. Follow these steps when decontaminating this equipment:

1. Establish a decontamination area with berms that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be utilized; otherwise, use one or more layers of heavy plastic sheeting to cover the

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5. If required by the site-specific field plans, rinse the item with 10% nitric acid (for stainless steel, glass, plastic, and Teflon), or 1% nitric acid (for items made of low-carbon steel) followed by a deionized water (ASTM Type II or better) rinse.

NOTE: Care should be taken not to get nitric acid on skin or clothing. This step should not be used unless required by sampling needs as dictated in the field plan.

CAUTION: Do not allow nitric acid to contact methanol or hexane. Contain nitric acid waste separate from organic solvents.

6. If sampling for organic analytes, rinse the item with methanol or approved organic solvent.
7. Rinse the item with deionized water (ASTM Type II or better).
8. If required by the field plan, when sampling for polar organic compounds such as pesticides, polychlorinated biphenyls (PCBs), and fuels, rinse the item with hexane or approved alternatives, followed by a second methanol rinse.
9. Allow the item to air dry completely.
10. After drying, wrap the clean item in plastic wrap or in aluminum foil, shiny side out.
11. Record equipment type, date, time, and method of decontamination in the appropriate logbook.
12. After decontamination activities are completed, collect all contaminated waters, used solvents and acids, plastic sheeting, and disposable gloves, boots, and clothing. Place contaminated items in properly labeled drums for disposal. Liquids and solids must be drummed separately. (Refer to site-specific plans for labeling and waste management requirements).

5.4 Pump Decontamination

Follow these steps when decontaminating pumps:

1. Set up the decontamination area and separate "clean" storage area using plastic sheeting to cover the ground, tables, and other porous surfaces. Set up three 55-gallon drums and one or more containers of ASTM Type II water (or as specified in the field plan) with one drum containing dilute (nonfoaming) soapy water, the second drum containing potable water, and the third drum receiving waste water.

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5. If using soapy water, rinse the equipment using clean, potable water. If using hot water, the rinse step is not necessary if the hot water does not contain a detergent. If the hot water contains a detergent, this final clean water rinse is required.
6. Using the manual-pump sprayer, rinse the equipment thoroughly with deionized water (ASTM Type II or better).
7. Remove the equipment from the decontamination area and place in a clean area upwind to air dry.
8. Record equipment type, date, time, and method of decontamination in the appropriate logbook.
9. After decontamination activities are completed, collect all contaminated waste waters, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal. Liquids and solids must be drummed separately.

5.3 Sampling Equipment Decontamination

Sampling equipment includes split spoons, spatulas, and bowls used for sample homogenization that directly contact sample media. Follow these steps when decontaminating this equipment:

1. Set up a decontamination line on plastic sheeting. The decontamination line should progress from "dirty" to "clean" and have an area located upwind for drying decontaminated equipment. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or the surfaces on which decontaminated equipment is to be placed for drying.
2. Before washing, disassemble any items that might trap contaminants internally. Do not reassemble these items until decontamination and air drying are complete. Wash items thoroughly in a bucket of low phosphate detergent and potable water. Use a stiff-bristle brush to dislodge any gross contamination (soil or debris).
3. Rinse the item in potable water. Rinse water should be replaced as needed, generally when cloudy.
4. Using a hand sprayer, wash bottles, or manual-pump sprayer, rinse the item with deionized water (ASTM Type II or better).

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water and rinse water onsite or in a sanitary sewage treatment plant rather than as a hazardous waste. If an industrial waste water treatment plant is available onsite, the disposal of acid solutions and solvent-water solutions may be permitted.

4. Unless required, plastic sheeting and disposable protective clothing may be treated as a solid, nonhazardous waste.

6.0 RESTRICTIONS/LIMITATIONS

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics respectively. These steps should not be used unless required because of acid burn and ignitability hazards.

If the field equipment is not allowed to air dry properly before use, volatile organic residue which interferes with the analysis may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted; in the summer, volatilization is rapid and in the winter, volatilization is slow. Check with your EPA region, state and client for approved decontamination solvents.

7.0 REFERENCES

Department of Energy, Hazardous Waste Remedial Actions Program, *Standard Operating Procedures For Site Characterization*, DOE/HWP-100, July 1990.

Department of Energy, Hazardous Waste Remedial Actions Program, *Quality Control Requirements For Field Methods*, DOE/HWP-69/RI.

American Society for Testing and Materials, *Standard Practice for Decontamination of Field Equipment at Nonradioactive Waste Sites*, ASTM D5088-90, June 29, 1990.

U.S. Environmental Protection Agency, Region II, *"CERCLA Quality Assurance Manual*, Revision 1, 1989.

U.S. Environmental Protection Agency, Region IV, *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*, 1986.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1, 1987.

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2. The pump should be set up in the same configuration as for sampling. Submerge the pump intake (or the pump, if submersible) and all downhole-wetted parts (tubing, piping, foot valve) in the soapy water of the first drum. Place the discharge outlet in the waste water drum above the level of the waste water. Pump soapy water through the pump assembly until it discharges to the waste drum.
3. Move the pump assembly to the potable water drum while leaving discharge outlet in the waste drum. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.
4. Move the pump intake to the ASTM Type II water can. Pump the ASTM Type II water through the pump assembly. Usually, three pump-and-line-assembly volumes will be required.
5. Decontaminate the discharge outlet by hand following the steps outlined in Section 5.3.
6. Remove the decontaminated pump assembly to the "clean" area and allow it to air dry upwind of the decontamination area. Intake and outlet orifices should be covered with aluminum foil to prevent the entry of airborne contaminants and particles.
7. Record the equipment type, serial number, date, time, and method of decontamination in the appropriate logbook.

5.5 Instrument Probe Decontamination

Instrument probes used for field instruments such as pH meters, conductivity meters etc. will be decontaminated between samples and after use with ASTM type II, or better, water.

5.6 Waste Disposal

Refer to site-specific plans for waste disposal requirements. The following are guidelines for disposing of wastes:

1. All wash water, rinse water, and decontamination solutions that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste.
2. Small quantities of decontamination solutions may be allowed to evaporate to dryness.
3. If large quantities of used decontamination solutions will be generated, it may be best to separate each type of waste in a separate container. This may permit the disposal of wash

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2.3 Associated Procedures

- CDM Federal Technical Standard Operating Procedure 4-1
- CDM Federal Quality Assurance Procedures 2.1 and 2.3
- CDM Federal Equipment Procedures
- Manufacturer's operating and maintenance and calibration procedures

3.0 RESPONSIBILITIES

All staff with responsibility for the direct control and/or use of measurement and test equipment (M&TE) are responsible for being knowledgeable of, and understanding and implementing the requirements contained herein as well as any other related project-specific requirement.

4.0 REQUIREMENTS

- Determine and implement M&TE related project-specific requirements
- The Manufacturer's Procedure (MP) or CDM Federal Equipment Procedure (EP) must be followed when using measurement and test equipment (M&TE)
- Obtain the manufacturer's procedures if they're missing or incomplete
- Attach (or include) an EP or the MP (as appropriate)
- Prepare, and record maintenance and calibration (M&C) in, an Equipment Log (EL)
- Prepare and/or use a Field Log (FL) when M&TE is in use in-situ
- Maintain M&TE records
- Label M&TE requiring routine or scheduled calibration
- Perform M&C using the appropriate procedure and calibration standard
- Identify and take action on non-conforming M&TE

5.0 PROCEDURES

5.1 Determine if Other Related Project-Specific Requirements Apply

For All M&TE Use

1. The Equipment Warehouse Manager (EWM), Equipment Coordinator (EC), other person responsible for the item (OPR) or user - contact the Project Manager (or appropriate Contract staff in the Project Managers absence) to determine if M&TE related project-specific requirements exist.
2. EWM, EC, OPR or user - if M&TE related project-specific requirements exist, obtain a copy of them and review and implement as appropriate.

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1.0 OBJECTIVE

The objective of this standard operating procedure is to establish the baseline requirements, procedures and responsibilities inherent to the control and use of all measurement and test equipment. Contractual obligations may require more specific or stringent requirements that must also be implemented.

2.0 BACKGROUND

2.1 Definitions

- Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

2.2 Discussion

Measurement and test equipment is typically either company owned, government furnished, or rented or leased from an outside vendor. It's essential that measurements and tests resulting from the use of this equipment are of the highest accountability and integrity. To facilitate that, the equipment shall be utilized in full understanding and compliance with the instructions and specifications included in the manufacturer's operations and maintenance and calibration procedures (hereafter referred to as the manufacturer's procedure) and in accordance with any other related project-specific requirement.

For some items of company owned measurement and test equipment, CDM Federal has prepared an Equipment Procedure document that incorporates the manufacturer's procedures and additionally specifies calibration and field check requirements and acceptance limits for calibration and field checks. In some instances government furnished measurement and test equipment may be identical to company owned items and a specific Equipment Procedure may exist that would apply to both. In these instances both company owned, and government furnished, measurement and test equipment shall be operated, maintained and calibrated in accordance with the specific Equipment Procedure. It's also recommended, but not required, that measurement and test equipment that is rented or leased from an outside vendor be operated, maintained and calibrated in accordance with the specific Equipment Procedure.

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FIGURE 1

CDM Federal Programs Corporation <small>A subsidiary of Corvo Drimmer & McKee Inc.</small>	MAINTENANCE AND CALIBRATION																
<p>Date: _____ Time: _____ AM/PM</p> <p>Employee Name: _____ Equipment Description: _____</p> <p>Contract/Project: _____ Equipment ID No.: _____</p> <p>Activity: _____ Equipment Serial No.: _____</p>																	
<u>MAINTENANCE</u>																	
<p>Maintenance Performed: _____</p> <p>_____</p> <p>_____</p> <p>Comments: _____</p> <p>_____</p> <p>_____</p> <p>Signature: _____ Date: _____</p>																	
<u>CALIBRATION/FIELD CHECK</u>																	
<table style="width: 100%;"><tr><td>Calibration Standard: _____</td><td>Concentration of Standard: _____</td></tr><tr><td>Lot Number of Calibration Standard: _____</td><td>Expiration date of Calibration Standard: _____</td></tr><tr><td>Pre-Calibration Reading: _____</td><td>Post-Calibration Reading: _____</td></tr><tr><td>Additional Readings: _____</td><td>Additional Readings: _____</td></tr><tr><td>Additional Readings: _____</td><td>Additional Readings: _____</td></tr><tr><td>Pre-Field Check Reading: _____</td><td>Post-Field Check Reading: _____</td></tr><tr><td>Adjustment(s): _____</td><td>_____</td></tr><tr><td>_____</td><td>_____</td></tr></table> <p>Calibration: <input type="checkbox"/> Passed <input type="checkbox"/> Failed</p> <p>Comments: _____</p> <p>_____</p> <p>Signature: _____ Date: _____</p>		Calibration Standard: _____	Concentration of Standard: _____	Lot Number of Calibration Standard: _____	Expiration date of Calibration Standard: _____	Pre-Calibration Reading: _____	Post-Calibration Reading: _____	Additional Readings: _____	Additional Readings: _____	Additional Readings: _____	Additional Readings: _____	Pre-Field Check Reading: _____	Post-Field Check Reading: _____	Adjustment(s): _____	_____	_____	_____
Calibration Standard: _____	Concentration of Standard: _____																
Lot Number of Calibration Standard: _____	Expiration date of Calibration Standard: _____																
Pre-Calibration Reading: _____	Post-Calibration Reading: _____																
Additional Readings: _____	Additional Readings: _____																
Additional Readings: _____	Additional Readings: _____																
Pre-Field Check Reading: _____	Post-Field Check Reading: _____																
Adjustment(s): _____	_____																
_____	_____																
1/97																	

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5.2 Obtain the Operating Documents

For Company Owned (CO) and Government Furnished (GF) M&TE that is to be procured:

1. Requisitioner - specify that the manufacturer's operating and M&C procedures be included.

For GF M&TE that is acquired as a result of a property transfer:

1. Recipient - inspect the M&TE to determine whether complete manufacturer's procedures are included with the item.
2. Recipient - if the manufacturer's procedures are missing or incomplete, order the appropriate documentation from the manufacturer.

For M&TE that is to be rented or leased from an outside vendor:

1. Requisitioner - specify that the manufacturer's operating and M&C procedures, latest calibration record, and standards certification be included.

5.3 Prepare an Equipment Log

For CO and GF M&TE:

1. Recipient - Notify the EWM, EC or OPR for the overall property control of the equipment, of the receipt of an item of M&TE.
2. EWM, EC or OPR - prepare a sequentially page-numbered EL for the item using the Maintenance and Calibration form from the CDM Federal Property Control Manual and included here for reference as FIGURE 1.

5.4 Label M&TE Requiring Calibration

For CO and GF M&TE only (does not apply to rented or leased M&TE):

1. EWM, EC, or OPR - read the MP or EP (as appropriate) to determine the frequency of calibration required.
2. EWM, EC, or OPR - if an M&TE item requires calibration before use, affix a label to the item stating "Calibrate Before Use".

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5.7 Record Keeping

For CO and GE M&TE:

1. EWM, EC or OPR - create a file upon the initial receipt of an item of M&TE or calibration standard. Organize the files by contract origin and by M&TE item and calibration standard. Store all files in a cabinet, file drawer, or other appropriate storage media, at the pertinent warehouse or office location.
2. EWM, EC or OPR - maintain all original documents in the equipment file except for the packing slip and FL.
3. Recipient - forward the original packing slip to Procurement and a photocopy to the EWM, EC or OPR.
4. EWM, EC or OPR - File the photocopy of the packing slip in the M&TE file.
5. EWM, EC, OPR or user - record all M&C in an EL or FL (as appropriate.) File the completed ELs in the M&TE records. Forward completed FLs to the Project Manager for inclusion in the project files.

For M&TE rented or leased from an outside vendor:

1. Recipient - Forward the packing slip to Procurement.
2. User - record M&C, and other related project-specific records in the FL and forward the completed log to the Project Manager for inclusion in the project files.
3. User - retain the most current M&C record and calibration standards certifications with the M&TE item and forward previous versions to the Project Manager for inclusion in the project files.

5.8 Traceability of Calibration Standards

For all items of M&TE:

1. EWM, EC, OPR or user - request nationally recognized standards as specified or required. Request commercially available standards when not otherwise specified or required. Or, request standards in accordance with other related project-specific requirements.

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3. EWM, EC or OPR - if an M&TE item requires calibration at other scheduled intervals, e.g. monthly, annually, etc., affix a label listing, the date of the calibration, the date the item is next due for a calibration, and the initials of the person performing the calibration.

5.5 Operating, Maintaining or Calibrating an M&TE Item

For CO and GE M&TE:

1. EWM, EC, OPR or user - operate, maintain or calibrate M&TE in accordance with the EP, or MP (as appropriate) and record M&C actions in the EL.

For M&TE that is rented or leased from an outside vendor:

1. EWM, EC, OPR or user - operate, maintain or calibrate M&TE in accordance with the MP and record actions in the FL.

5.6 Shipment

For CO and GE M&TE:

1. All shippers - inspect the item to ensure that the EP or MP (as appropriate) is attached to the shipping case, or included, and that a copy of the most recent EL entry page is included with the shipment.
2. All shippers - if an EP or MP (as appropriate) and/or the current EL page is missing or incomplete, do not ship the item, immediately contact the EWM, EC or OPR and request a replacement.

For M&TE that is rented or leased from an outside vendor:

1. All shippers - inspect the item to ensure that the manufacturer's operating procedures, M&C procedures and latest calibration and standards certification records are included prior to shipment.
2. All shippers - if any documentation is missing or incomplete, do not ship the item. Immediately contact Procurement and request that they obtain the documentation from the vendor.

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2. EWM, EC, OPR or user - require certifications for standards which clearly state the traceability.
3. EWM, EC, OPR or user - note standards that are perishable and consume or dispose of them on or before the expiration date.

5.9 M&TE That Fails Calibration

For any M&TE item that cannot be calibrated or adjusted to perform accurately:

1. EWM, EC, or OPR performing routine M&C - immediately discontinue use, segregate the item from other equipment, and take appropriate action in accordance with the CDM Federal Quality Procedure for non-conforming items.
2. In-situ user - immediately discontinue use and segregate the item from other equipment. Notify the appropriate Project Manager as well as the EWM, EC or OPR for that M&TE item and take appropriate action in accordance with the CDM Federal Quality Procedure for non-conforming items.
3. EWM, EC, OPR or user - review the current and previous M&C records to determine if the validity of current or previous measurement and test results could have been affected and notify the appropriate Project Manager(s) if a potential negative impact is determined.

6.0 RESTRICTIONS/LIMITATIONS

On an item by item basis, exemptions from the requirements of this Standard Operating Procedure may be granted by the Headquarters Administrative Manager with the concurrence of appropriate Headquarters Health and Safety and/or Quality Assurance staff. All exemptions from this Standard Operating Procedure shall be documented by the Headquarters Administrative Manager and included in the equipment records as appropriate.

7.0 REFERENCES

- CDM Federal Programs Corporation Quality Assurance Manual
- CDM Federal Programs Corporation Property Control Manual
- CDM Federal Programs Corporation Technical Standard Operating Procedures

NOTE: THE FOLLOWING MAY BE SUPERSEDED BY MORE STRINGENT SITE-SPECIFIC OR CLIENT REQUIREMENTS.

EP NO. C.2

REVISION NO.: 1

EQUIPMENT PROCEDURE: OVM/DATALOGGER, MODEL 580

MANUAL: P/N 16860

6/7/94

Application	Calibration Frequency		Calibration Standard	Initial Calibration Tolerance		Post-Run Calibration Tolerance		Calibrated Instrument Range	Field Check Frequency	Field Check Acceptance Range	Maintenance Frequency	
	PRIMARY	FIELD		PRIMARY	FIELD	PRIMARY	FIELD				PRIMARY	FIELD
All applications	S	When the unit fails to meet the field check acceptance range.	--Primary-- NIST traceable I-C ₄ H ₆ in air. --Field-- Commercially available I-C ₄ H ₆ in air.	± 0.5 ppm of the STD.	± 5% of the STD.	N/A	± 25% of the STD.	0.1 - 2000 ppm	Beginning and end of each day.	± 30% of the STD.	S	N/A

DEFINITIONS

Applications: Lists the equipment uses covered in this EP. The uses are listed individually if a change in application also changes the parameters used, or if the procedures covered do not include all possible uses for the instrument. Parameters for most equipment remain unchanged when the use changes.

Calibration Frequency: The longest interval acceptable before either a field calibration or a primary calibration is required.

Calibrated Instrument Range: This is the operating range of a properly calibrated instrument.

Calibration Standard: The type of standard used to calibrate the equipment. Standards used for primary calibrations must be traceable to a nationally recognized standard, where they exist. Most field calibrations can be performed with commercially available standards.

Calibration Check Value: The value calculated after the final adjustments of a calibration procedure, or at the end of a field check procedure. Several readings are taken (at least three), and an average of these readings is the calibration check value of the instrument. The calibration check value is referenced to the initial calibration tolerance. Calibration check values are recorded in the equipment maintenance and calibration log book.

Field Calibration: Procedure used in the field to check and adjust an instrument against a known standard. Most field calibrations can be performed with commercially available standards. After final adjustments, the standard is read back several times and an average is calculated. This average is the calibration check value and it must meet the initial calibration tolerance for field calibrations. Field calibration readings are recorded in the equipment maintenance and calibration log book.

Field Check: Procedure used in the field to check an instrument against a known standard. The field check is less extensive than a field calibration, and there are typically no adjustments. A calibration is required if the field check fails to meet the field check acceptance range. Field check readings are recorded in the equipment maintenance and calibration log book.

Field Check Acceptance Range: The range that the field check reading may deviate from the calibration standard, and still be considered acceptable. A field calibration is required if the readings fall outside of this range. Data collected with an instrument after it has failed a field check or a field calibration, may be found to be unacceptable.

Field Check Frequency: The longest interval acceptable before another field check is required, and a post-run reading is recorded. Field checks are applicable when a field calibration procedure is not possible, practical, or necessary.

Field Procedures: All procedures conducted at other than 'primary' facilities. Field calibrations and field maintenance procedures are normally less extensive than those performed at a primary facility.

Initial Calibration Tolerance: The accuracy to which the equipment must be adjusted for a valid calibration. After final adjustments, the standard is read back a minimum of three times and an average is calculated. This average is the calibration check value and it must fall within the initial calibration tolerance.

Maintenance Frequency: The interval of time before scheduled maintenance must be performed on an instrument; (ex. sensor replacement, seal replacement, internal cleaning, lamp cleaning, etc.). Maintenance is performed at primary facilities.

Post-Run Calibration Tolerance: The range that the post-run reading must be within for the instrument to be considered in good working condition. Data collected with an instrument between the last passed calibration or check, and a failed post-run calibration or check, may be found to be unacceptable.

Post-Run Reading: The reading taken at the end of a field check frequency interval, or at the end of a calibration frequency interval. Readings taken at the end of a field check interval must meet the field check acceptance range. Readings taken at the end of a calibration interval must meet the post-run calibration tolerance. Post-run readings are recorded in the equipment maintenance and calibration log book.

Primary Facilities: Facilities where more extensive repairs and more accurate calibrations are performed than required in the field. Facilities will be designated 'primary facilities' by Fairfax ESC. Examples may include Fairfax ESC, authorized CDM Federal warehouses, the instrument's manufacturer, a distributor's service center, certified repair companies, etc.

Primary: Procedures conducted at primary facilities using more stringent maintenance and calibration guidelines and using nationally recognized calibration standards.

SECTION I

INTRODUCTION

1 INTRODUCTION

The 580B is a portable Organic Vapor Meter (OVM), which detects and quantitates most organic vapors with a highly sensitive photoionization detector (PID). The 580B has an operating range of 0-2000 parts per million (ppm) with a minimum detectable of 0.1 ppm. No support gases are required.

The 580B is controlled by a microprocessor which provides many features that were not previously available. Maximum signal hold, detector linearization, overrange lockout, IBM PC (or compatible) interface, extensive data logging capabilities and much more. With the many features provided by the 580B leak detection, head space measurements, and field survey are all easily accomplished. Completely portable, the 580B operates from internal batteries for eight hours in the field.

1.1 ABOUT THIS MANUAL

This manual is broken down into eight chapters. The first chapter (this one) provides a general overview of the 580B. Chapter two discusses, in great detail, the extensive facilities of the 580B. The focus of this chapter is on how to use the seven switches to access the various facilities. Chapter three explains, in detail, how to perform routine maintenance on the 580B. Chapter four is a technical discussion of calibration and methods for generating standards. Chapter five is a technical discussion of a few applications which illustrate some of the uses of the 580B. Chapter six is a technical discussion of methods for collecting a sample using the 580B. Chapter seven is a discussion of the communication facilities provided by the 580B. Chapter eight contains two flow charts which illustrate the 580B software flow. This chapter is a helpful tool for the new user. Appendix A is a detailed explanation of the 580B communication protocol. This chapter is provided in order to allow a programmer to develop specialized communication software for the 580B. There are several other addendums which contain miscellaneous information about the 580B.

1.2 INSTRUMENT OVERVIEW

This section describes various points of interest on the 580B. Each number refers to a number in Figure 1.1.

1. **POWER PLUG** - The power plug is used to run the instrument from its internal batteries. There is a chain attached to the power plug so that it will not be lost.

2. **RS-232 CONNECTOR** - This connector is used for communi-

cation with a serial printer or computer. A communication cable provided with the instrument fits into the receptacle.

3. **KEY PAD** - There are seven switches which operate the 580B. The switch marked ON/OFF is used to turn the pump and lamp on and off. The switch marked LIGHT will turn on backlighting for the two line display. The other five switches perform various functions. For a detailed description of the function of each switch see chapter two or the flow charts in chapter eight.

4. **DISPLAY** - The 580B has a two line by sixteen character display.

5. **SHOULDER STRAP** - There is an adjustable shoulder strap for carrying the 580B.

6. **SAMPLE EXIT PORT** - The 580B sample is drawn into the detector by a positive displacement pump and then sent back out through the exit port.

NOTE : The photoionization detector is a non destructive detector so the sample may be collected at the exit for further analysis (see Chapter Six).

7. **PUMP** - The 580B pump draws the sample into the detector.

8. **MOUNTING SCREWS** - There are four captive screws which hold the 580B top and bottom together. The screws are specially designed so that they do not fall out when they are loosened out of the case top.

9. **DETECTOR** - The photoionization detector is shown with the lamp and high voltage power supply.

10. **SAMPLE INLET** - Sample is drawn into the detector through the sample inlet at the front of the 580B.

11. **SIGNAL CABLE** - The PID signal is brought up to the microprocessor, for analysis, via the coaxial signal cable.

12. **BASE HARNESS** - The base harness plugs into a connector on the case top.

1.3 580B FEATURES

This section provides a brief overview of the various features of the 580B. After reading this section the user should have a good idea of what the instrument can do. Chapters two and three will explain, in detail, how each feature is selected.

TURNING ON PUMP AND LAMP - The pump and lamp are turned on by pressing the ON/OFF switch (the instrument power must already be on).

CALIBRATION - Calibration of the 580B is extremely impor-

and instrument number are also provided.

CLOCK - The 580B has an internal clock which will run even when the instrument power is cut off.

COMMUNICATION - The 580B has a serial communication port for outputting data to a serial printer. Many of the 580B features may be accessed from a remote computer through the serial communication port (there is communication software available which will run on an IBM PC or clone).

DISPLAY LOGGED DATA - The logged data may be displayed on the 580B's two line display.

instrument it is suggested that the user prepare a number of standards of different compounds and measure them relative to isobutylene. Included in this comparison should be several mixtures of compounds such as gasoline, paint thinner, or cleaning solvent, etc. Through this type of study the inequity of the PID response will be better understood making the Model 580 a more effective tool. The use of the instrument is discussed in greater detail in subsequent sections.

2.1.5 PHOTOIONIZATION DETECTOR

The detector is constructed of Teflon and stainless steel to eliminate chemical interaction with the surfaces that are encountered by the sample. To further reduce possible interaction with the surfaces, the flow rate thru the detector is high, 400 - 500 cc/min developing a very dynamic transport of the sample.

Referring to Figure 2.1, the sample is drawn into the ionization chamber through the jet electrode where the UV radiation from the lamp ionizes the sample. A bias voltage of several hundred volts is applied to the jet to aid in the collection of ions. As a result of the ionization process and the impingement of the UV energy from the lamp on the sample, positively charged ions and free electrons are produced. The jet is negative relative to the collector where the electrons are collected.

Between the jet and the collector, separated on both sides by Teflon, is the guard electrode. Its function is to eliminate surface currents which could flow between the two active electrodes. When the Teflon surfaces become dirty during use, there can be the development of a conduction path on the Teflon, which increases in high humidity situations. The guard electrode eliminates this path. The collector electrode is connected to the electrometer which measures the ion current produced during the ionization process. The sample is moved through the detector by an external pump which is on the exit of the detector.

2.2 PROGRAM OPERATION

2.2.1 INTRODUCTION

The 580B has seven switches located just below the display. They are labeled:

ON/OFF MODE/STORE RESET LIGHT +/-INC -/CRSR SPKR

The ON/OFF switch toggles the lamp and pump power between on and off. The MODE/STORE, RESET, +/-INC, -/CRSR and SPKR switches all have various meanings (including none at all) depending upon the mode. The SPKR switch normally is used to toggle the instrument speaker between on and off. Pressing the MODE/STORE switch will cause the 580B to return to the Run mode, except when the 580B is already in this mode. In which case it will cause the 580B to enter the Log mode.

The LIGHT switch is used to illuminate the display.

features. Readings may be stored for later analysis. Each reading will have a date and time as well as a location code associated with it. Up to over 700 readings may be stored. Logged data may even be sent to a printer or computer via an RS-232 serial communication port (see section 2.7).

The Log mode is entered from the Run mode by pressing the MODE/STORE switch. When this switch is pressed from the Run mode the display will show:

LOG THIS VALUE?

on the top line and either PPM or MAX PPM on the bottom line depending upon which run mode the 580B is currently in. By pressing the +/-INC switch the display will then show:

LOC. CODE 000001

on the top line (the actual location code may not be 000001). The location code may now be entered. By pressing the +/-INC switch the number above the cursor may be incremented. By pressing the -/CRSR switch the cursor may be moved to the next digit. The 580B automatically increments the location code each time a data point is logged.

Once the desired location code has been entered, pressing the MODE/STORE switch will "log" the data point. This means that the reading displayed on the bottom line, along with the location code, the current date and the current time will be stored into the 580B's memory. The 580B will then return to the Run mode.

If for any reason logging is not desired, pressing the RESET switch rather than the MODE/STORE switch will cause the value not to be stored. The 580B will then go back to displaying:

LOG THIS VALUE?

Pressing the mode switch will now return the 580B to the Run mode.

It is possible, when attempting to log a data point, that rather than the display showing "LOC. CODE 000001" it will show "BAR CODE: .". Don't be alarmed. This has happened because the location mode selection is not properly set. Section 2.4.3 describes how to set this parameter. Pressing the mode/store switch will cancel the logging operation and return to the run mode. The location mode selection should be changed as described in section 2.4.3.

2.2.4A AUTO LOGGING MODE

The 580B may be instructed to automatically log data according to a predefined time interval. AUTO LOGGING is selected from within the Parameters section (see section 2.4). At the end of the logging interval (settable from 1 second up to 99 minutes and 59 seconds) the current average ppm value will be logged and the logging interval will be restarted.

The other four operating modes (Communication, Parameters, Access and Clock) may be entered from the Main menu. The operating mode may always be returned to by pressing the MODE/STORE switch.

2.4 PARAMETERS MODE

All of the 580B operating parameters are entered in the Parameters mode. The 580B is also calibrated from within the Parameters mode.

The Parameters mode may be entered by pressing the -/CRSR switch from the main menu.

There are nine different sections in the Parameters mode.

1. Run mode selection
2. Auto logging selection
3. Location mode selection
4. Average time selection
5. Alarm setting
6. Lamp selection
7. Response factor setting
8. Calibration
9. Free space indication

Pressing the +/INC switch will advance the 580B to the next section. Pressing the -/CRSR will advance the 580B to the previous section. Each section and any of its sub-sections will be described in the following pages. It is important to note that when the 580B is in a sub-section of any of the above sections that the +/INC and -/CRSR switches will have a different meaning. This may seem confusing at first but will become clear after stepping through each section.

2.4.1 RUN MODE SELECTION

There are two Run modes. Concentration meter normal and Max Hold (see Section 2.2.3). The top line of the display will show:

CONC. METER

the bottom line will show:

"RESET" TO CHG

the bottom line will alternate every two seconds with:

MAX HOLD

if the 580B is in the Max Hold mode. Pressing the RESET switch will cause the 580B to show:

MAX HOLD
+ = USE/ - = NO

The 580B is now configured for the alternate location mode (which is not presently available for use in hazardous locations). Pressing the reset switch will cause the 580B to be configured for location code mode.

2.4.4 AVERAGE TIME SELECTION

The 580B can be configured to display the average PPM from once a second up to once every four minutes. The display will show:

AVERAGE = 0:01
"RESET" TO CHG

Pressing the RESET switch will cause the 580B to show:

AVERAGE = 0:01
"RESET"WHEN DONE

The +/-INC switch will increment the number above the cursor and the -/CRSR switch will move the cursor. The average time format is M:SS (where M is minutes and S is seconds).

NOTE: The maximum averaging interval is four minutes.

2.4.5 ALARM SETTING

The 580B will display the current alarm setting on the top line of the display. The setting may be changed by simultaneously pressing the RESET switch with either the +/-INC switch to increment the digit above the cursor or the -/CRSR switch to move the cursor.

2.4.6 LAMP SELECTION

The 580B will display:

LAMP

on the top line. The bottom line will alternate every two seconds between:

"RESET" TO CHG

and the currently selected lamp setting and its associated serial number.

i.e.

11.8eV 000000

By pressing the RESET switch, the 580B will display:

+/-10eV -/11eV

Once zero gas has been introduced the RESET switch should be pressed. The 580B will then zero the instrument. The 580B will display:

MODEL 580B
ZEROING

Once the 580B has been zeroed the 580B will display:

SPAN PPM = 0000

The Span gas concentration may now be entered by simultaneously pressing the RESET switch and either the +/INC switch to increment the digit above the cursor or the -/CRSR switch to move the cursor. Once the span gas concentration has been entered the +/INC switch should be pressed.

The 580B will then display:

SPAN GAS
RESET WHEN READY

Once the span gas has been introduced the RESET switch should be pressed. The 580B will then calibrate the instrument. The 580B will display:

MODEL 580B
CALIBRATING

Once the 580B has been calibrated the 580B will go back to the beginning and display:

"RESET" TO
CALIBRATE

If during the zeroing or calibrating of the 580B a steady reading was not seen then the 580B will display:

CAL ERROR
RESET WHEN READY

Pressing the RESET switch will return the 580B to zeroing or calibrating (depending of course on which it came from).

See Section 4.1 for tips on calibrating the 580B.

2.4.9 FREE SPACE INDICATION

This section will give a rough indication of how much room is left for logging data points. The screen will display a bar graph on the top line and the amount of free space on the bottom line. The number indicates the total number of bytes which are available. Each data point takes fifteen bytes. Other bytes may also be needed in order to store other important information. This is why only a rough indication of room may be given.

4.4 580B CALIBRATION

The following procedure is applicable for both Cylinder and Bag Standards. The sequence requires both Zero gas and Span gas to be used. Span gas can be either contained as a cylinder or bag, in either case the exact concentration used must be known. This concentration will be entered to the 580 when the program provides its entry. With respect to Zero gas, there are several choices. Obviously a certified zero air standard in a cylinder presents no problem. Another choice would be to build a zero air standard in a bag. This can be simply accomplished with the set-up in Figures 4.1 and 4.2 using a charcoal scrubber to remove all the hydrocarbons present in the air. Charcoal does not absorb Methane; this does not cause a problem because the PID does not respond to it. Another approach which could be used in an emergency is to use room air unscrubbed.

This is acceptable if you know that there are no hydrocarbons present or they are exceptionally low in concentration. However, it is not recommended as a standard practice. The physical set up for cylinder calibration is illustrated in Figure 4.1; bag calibration in Figure 4.2.

4.4.1 CALIBRATION ROUTINE

- (A) Set-up calibration assembly with zero air cylinder or bag as described in Figures 4.1 and 4.2.
- (B) Model 580B set-up and zero calibration.

1. Power-up instrument using power plug.
2. Depress ON/OFF Key to ignite lamp and initiate sample pump.
3. Depress MODE/STORE Key.
4. Depress-/CRSR Key in response to LOG THIS VALUE? Prompt.
5. Depress-/CRSR Key to select Parameters Mode from the Main Menu.
6. Depress +/-INC Key to advance thru the Run Mode selection parameter prompt.
7. Depress +/-INC Key to advance thru the Auto Logging Mode selection parameter prompt.
8. Depress +/-INC Key to advance thru the Average Time selection parameter prompt.
9. Depress +/-INC Key to advance thru the Alarm Setting parameter prompt.
10. Depress +/-INC Key to advance thru Lamp Selection parameter prompt.
11. Depress +/-INC Key to advance thru Response Factor Setting parameter prompt.
12. Depress RESET Key to initiate calibration sequence.
13. Depress-/CRSR Key to decline restoration of the backup calibration.
14. Connect outlet of calibration tubing assembly to the Model 580B Detector Inlet as illustrated in Figure 4.2.
15. Introduce Zero Air to Model 580B by opening flow regulator.

know that the sample to be measured contains only benzene and therefore the user would like to read benzene concentration directly, there are two approaches. The user could make a bag standard daily of benzene vapor in air and calibrate the 580 directly. Or the Response Factor could be used. In the latter case a bag with benzene is made only once for comparison to a cylinder of a stable standard (such as isobutylene). Then daily, the Model 580 is calibrated with the cylinder standard, a simple operation compared to the work of preparing a bag standard.

As an example, if the bag containing 55 ppm benzene in air as prepared above were measured in a 580 calibrated against isobutylene, the concentration might have been read as 91 ppm. thus the 580 is more sensitive for benzene than for isobutylene.

The Response Factor can now be calculated as:

$$\text{Response Factor (RF)} = \frac{\text{Factor STD Concentration}}{\text{580 Reading of Factor STD}}$$

$$\text{RF} = 55/91 = 0.604$$

When 0.60 is entered into the 580 as the Response Factor, the 580 will read 55 ppm for the bag.

Now the 580 need only be calibrated using an isobutylene standard and a Response Factor of 0.60 to correctly respond to benzene.

NOTE: THE FOLLOWING MAY BE SUPERSEDED BY MORE STRINGENT SITE-SPECIFIC OR CLIENT REQUIREMENTS.

EP NO. C.3
REVISION NO.: 1

**EQUIPMENT PROCEDURE: HNU MODEL PI 101/PHOTOIONIZATION ANALYZER
MANUAL: DECEMBER 1985**

6/7/94

Application	Calibration Frequency		Calibration Standard	Initial Calibration Tolerance		Post-Run Calibration Tolerance		Calibrated Instrument Range	Field Check Frequency	Field Check Acceptance Range	Maintenance Frequency	
	PRIMARY	FIELD		PRIMARY	FIELD	PRIMARY	FIELD				PRIMARY	FIELD
All applications	S	When the unit fails to meet the field check acceptance range.	-Primary-- NIST traceable I-C ₄ H ₄ in air. -Field-- Commercially available I-C ₄ H ₄ in air.	± 0.5ppm of STD.	± 5% of STD.	N/A	± 25% of the calibrated value.	0.1 - 2000ppm	Beginning and end of each day.	± 30% of the calibrated value.	S	N/A

DEFINITIONS

Applications: Lists the equipment uses covered in this EP. The uses are listed individually if a change in application also changes the parameters used, or if the procedures covered do not include all possible uses for the instrument. Parameters for most equipment remain unchanged when the use changes.

Calibration Frequency: The longest interval acceptable before either a field calibration or a primary calibration is required.

Calibrated Instrument Range: This is the operating range of a properly calibrated instrument.

Calibration Standard: The type of standard used to calibrate the equipment. Standards used for primary calibrations must be traceable to a nationally recognized standard, where they exist. Most field calibrations can be performed with commercially available standards.

Calibration Check Value: The value calculated after the final adjustments of a calibration procedure, or at the end of a field check procedure. Several readings are taken (at least three), and an average of these readings is the calibration check value of the instrument. The calibration check value is referenced to the initial calibration tolerance. Calibration check values are recorded in the equipment maintenance and calibration log book.

Field Calibration: Procedure used in the field to check and adjust an instrument against a known standard. Most field calibrations can be performed with commercially available standards. After final adjustments, the standard is read back several times and an average is calculated. This average is the calibration check value and it must meet the initial calibration tolerance for field calibrations. Field calibration readings are recorded in the equipment maintenance and calibration log book.

Field Check: Procedure used in the field to check an instrument against a known standard. The field check is less extensive than a field calibration, and there are typically no adjustments. A calibration is required if the field check fails to meet the field check acceptance range. Field check readings are recorded in the equipment maintenance and calibration log book.

Field Check Acceptance Range: The range that the field check reading may deviate from the calibration standard, and still be considered acceptable. A field calibration is required if the readings fall outside of this range. Data collected with an instrument after it has failed a field check or a field calibration, may be found to be unacceptable.

Field Check Frequency: The longest interval acceptable before another field check is required, and a post-run reading is recorded. Field checks are applicable when a field calibration procedure is not possible, practical, or necessary.

Field Procedures: All procedures conducted at other than 'primary' facilities. Field calibrations and field maintenance procedures are normally less extensive than those performed at a primary facility.

Initial Calibration Tolerance: The accuracy to which the equipment must be adjusted for a valid calibration. After final adjustments, the standard is read back a minimum of three times and an average is calculated. This average is the calibration check value and it must fall within the initial calibration tolerance.

Maintenance Frequency: The interval of time before scheduled maintenance must be performed on an instrument; (ex. sensor replacement, seal replacement, internal cleaning, lamp cleaning, etc.). Maintenance is performed at primary facilities.

Post-Run Calibration Tolerance: The range that the post-run reading must be within for the instrument to be considered in good working condition. Data collected with an instrument between the last passed calibration or check, and a failed post-run calibration or check, may be found to be unacceptable.

Post-Run Reading: The reading taken at the end of a field check frequency interval, or at the end of a calibration frequency interval. Readings taken at the end of a field check interval must meet the field check acceptance range. Readings taken at the end of a calibration interval must meet the post-run calibration tolerance. Post-run readings are recorded in the equipment maintenance and calibration log book.

Primary Facilities: Facilities where more extensive repairs and more accurate calibrations are performed than required in the field. Facilities will be designated 'primary facilities' by Fairfax ESC. Examples may include Fairfax ESC, authorized CDM Federal warehouses, the instrument's manufacturer, a distributor's service center, certified repair companies, etc.

Primary: Procedures conducted at primary facilities using more stringent maintenance and calibration guidelines and using nationally recognized calibration standards.

SECTION 2

OPERATION

2.1 INTRODUCTION/UNPACKING

Unpack the instrument carefully. The carton will contain the housing, straps, battery charger, additional probes, regulator and cylinder if ordered, spare parts, supplies and a manual. Be sure all items are removed before discarding the carton.

Attached to the instrument is a warranty card which should be filled out completely and returned to HNU Systems.

2.2 CONTROLS AND INDICATORS

The controls and indicators are located on the front panel of the readout assembly (see Figure 2-1) and are listed and described in Tables 2-1 and 2-2.

2.3 OPERATING PROCEDURES

The following procedures are to be used in operating the analyzer:

- a. Unclamp the cover from the main readout assembly.
- b. Remove the inner lid from the cover by pulling out the two fasteners.
- c. Remove the probe, handle and cable from the cover. Attach the handle to the front part of the probe.
- d. Connect the probe cable plug to the 12 pin keyed socket on the readout assembly panel. Carefully match the alignment slot in the plug to the key in the connector. Screw down the probe connector until a distinct snap and lock is felt.
- e. Screw the probe extension into the probe end cap. The probe may be used without the extension if desired.

Change -> f. Set the SPAN control for the probe being used (10.2, 9.5, or 11.7 eV) as specified by the initial factory calibration or by subsequent calibrations.
See EP cover sheet section:

TABLE 2-1

CONTROLS

Name	Position	Function

Function Switch	---	Controls the operation of the analyzer
	OFF	All operations OFF
	BATT (battery check)	Checks the condition of the battery. If the meter needle is in the green arc, the battery is charged. If not the battery should be recharged. Charging can be done in any position, best in OFF; see directions on charger.
	STANDBY	All electronics ON, ultraviolet (UV) light source OFF. This position conserves power and extends battery life. This position is used to set the analyzer zero position. (i.e. no UV light, no signal)
	0-2000	Sets range of meter at 0-2000 ppm.
	0-200	Sets range of meter at 0-200 ppm.
	0-20	Sets range of meter at 0-20 ppm.
ZERO	---	With the function switch in STANDBY position, this potentiometer is used to adjust the reading to zero.

NOTE: See Figure 2-1 for locations.

TABLE 2-2
INDICATORS AND DISPLAYS

Name	Function
Low Battery Indicator Light (red light) (see NOTE)	Illuminates when battery is discharged, indicates need for recharge.
	Do not use unit when this light is ON.
	Readings may be taken while battery is being recharged.
Meter (see NOTE)	Indicates concentration of measured gas.
Recorder (optional) (see Figures 2-1 And 8-3)	Provides a record of readings while analyzer operates unattended. Recorder inputs 0 to -5 V DC.

NOTE: See Figure 2-1 for locations.

SECTION 2.3. OPERATING PROCEDURES cont.

- n. The analyzer is now operational.
- o. Hold the probe so that the extension is at the point where the measurement is to be made. The instrument measures the concentration by drawing the gas in at the end of the extension, through the ionization chamber, and out the handle end of the probe.

----- WARNING -----

The instrument measures gases in the vicinity of the operator and a high reading when measuring toxic or explosive gases should be cause for action for operator safety.

- p. Take the reading or readings as desired taking into account that air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings. Change the ranges as required.
- q. Check battery condition as required. If the Low Battery Indicator comes on, turn analyzer off and recharge.

----- CAUTION -----

Use only in an emergency with a low battery when on battery charge.

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

Maintenance of the analyzer consists of cleaning the lamp and ion chamber, replacement of the lamp or other component parts or subassemblies.

WARNING: Turn the function switch on the control panel to the OFF position before any disassembly. Otherwise, high voltage of 1200 V DC will be present.

WARNING: Use great care when operating the analyzer with the readout assembly outside its case due to the presence of 1200 V DC.

WARNING: Do not look at the light source from any closer than 6 inches with unprotected eyes. Observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

CAUTION: Do not interchange lamps of different eV ratings in a probe. Amplifier and components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

5.2 UV LAMP AND ION CHAMBER CLEANING

During periods of operation of the analyzer, dust or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition monthly or as required. Cleaning can be accomplished as follows:

- a. Disassemble the probe and remove the lamp and ion chamber (see Section 5.5). Exercise great care in doing so to prevent inadvertent damage to these components.
- b. First check the lamp window for fouling by looking at the surface at an incident angle. Any deposits, films or discoloration may interfere with the ionization process. Clean the window as follows:

5.3 LAMP REPLACEMENT

To replace the lamp, disassemble the probe, remove the old lamp, install a new one of the same eV rating and reassemble.

----- WARNING -----

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of 1200 V DC will be present.

----- CAUTION -----

Do not exchange lamps of different eV ratings in a probe. Amplifier and components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

Set the SPAN pot to 9.3 for the 10.2 eV lamp. Remove the readout assembly case (see Section 5.6). Locate the gain control potentiometer, R4C, on the power supply board as shown on Figure 6-1. Recalibrate the analyzer adjusting this potentiometer, R4C, with a small screwdriver to obtain the specified ppm reading, leaving the SPAN pot set at 9.3.

For the 9.5 and 11.7 eV lamps see the Application Data Sheet or calibrations memo for the proper span pot settings and readings.

----- WARNING -----

Use great care when operating the analyzer with the readout assembly outside its case due to the presence of 1200 V DC.

When calibration is accomplished, turn the analyzer OFF and replace the readout assembly in its case.

Adjustment of R43 potentiometer is used only when a new lamp is installed. At all other times adjustment is accomplished using the SPAN control potentiometer.

If calibration cannot be achieved, see Section 6, Troubleshooting.

SECTION 5.5, PROBE DISASSEMBLY/ASSEMBLY cont.

Disconnect the probe cable connector at the readout assembly. Disassemble the probe by first removing the exhaust screw at the base of the probe adjacent to the handle (see Figure 5-1). Grasp the end cap in one hand and the probe shell in the other, gently pull to separate the end cap and the lamp housing from the shell.

Hold the lamp housing with the black end cap upright. Loosen the screws on the top of the end cap, separate the end cap and ion chamber from the lamp and lamp housing.

----- CAUTION -----

Care must be taken so that the ion chamber does not fall out of the end cap or the light source does not fall out of the lamp housing.

Turn the end cap over in the hand. Tap lightly on the top. The ion chamber should fall out of the end cap into the hand.

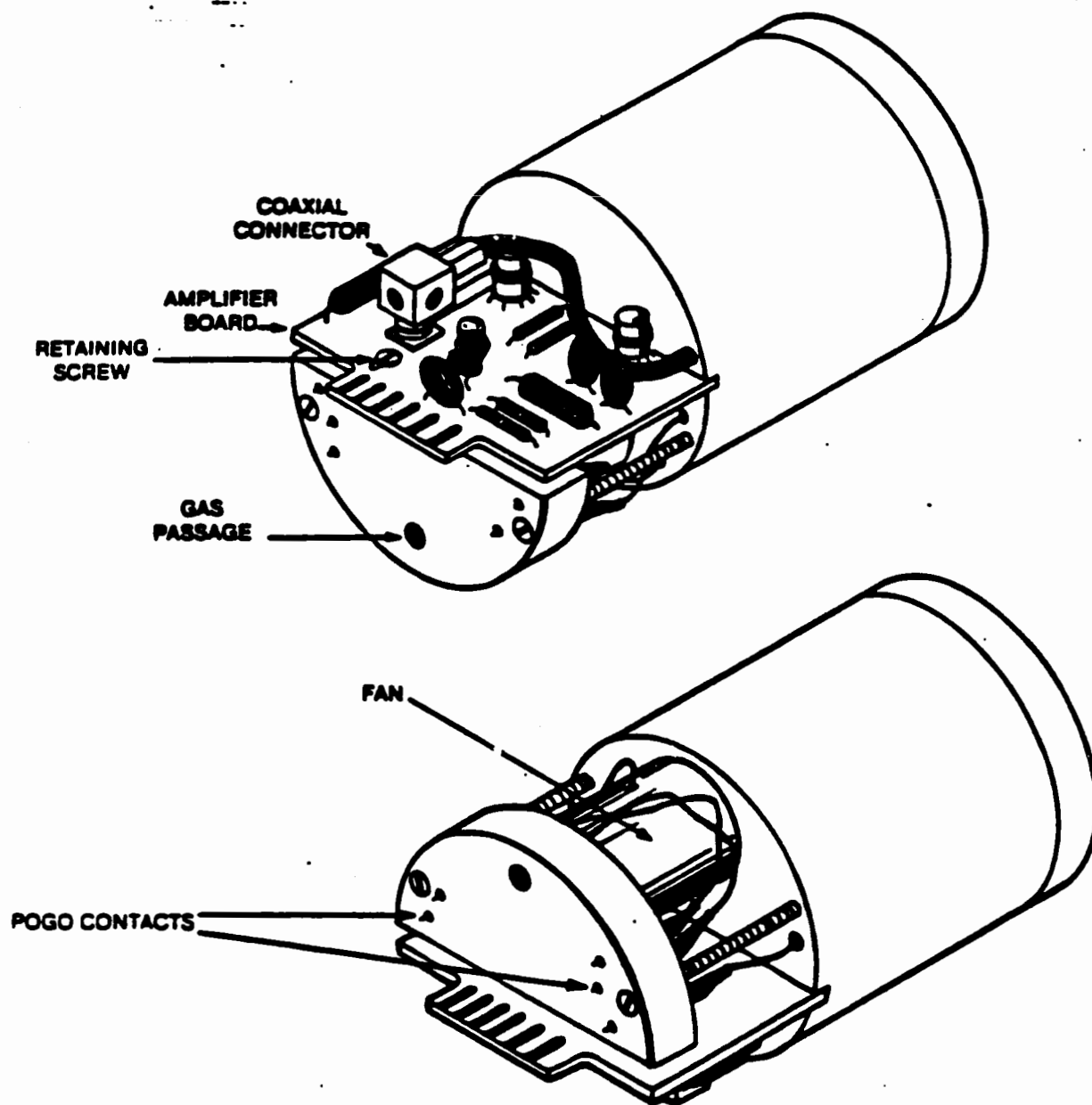
Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.

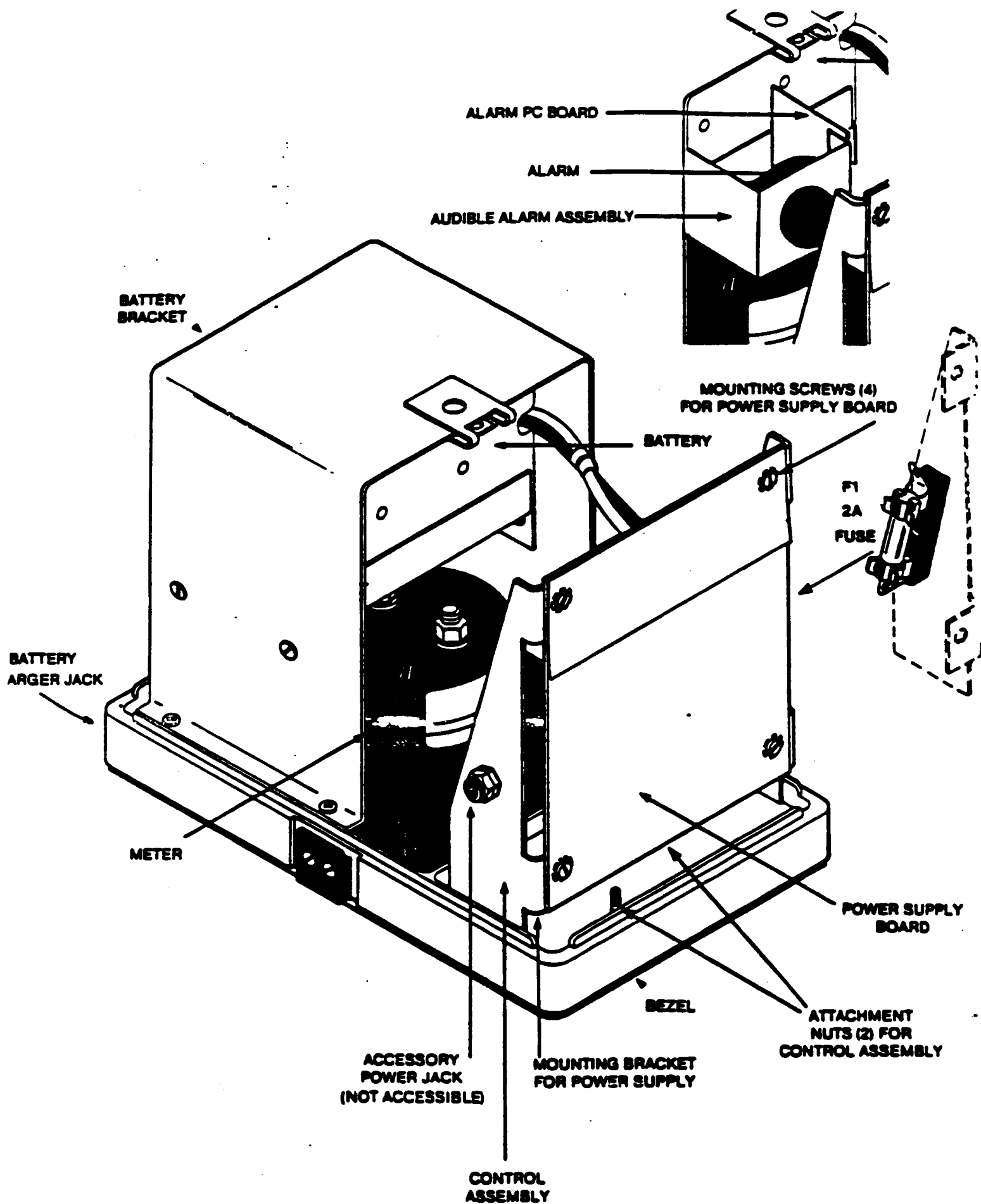
The amplifier board can be removed from the lamp source housing assembly (see Figure 5-2) by unsnapping the coaxial connector, J1, and then removing the retaining screw. The amplifier board will then slide out of the housing assembly.

Reassemble the probe by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, making sure that the contacts are properly aligned. The ion chamber fits only one way.

If the ion chamber is to be replaced always use one identical to the one being removed. Check the aperture (small: 3.0 mm; large: 6.0 mm) at the top of the ion chamber and materials of construction (gold-plated or Teflon) to ensure proper replacement. See Parts List, Section 7.

Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring.





2 CALIBRATION CHECKING WITH ISOBUTYLENE

The calibration of the analyzer can be rapidly checked by the use of an HNU small disposable cylinder containing isobutylene (HNU pn 101-350) with a regulator (HNU pn 101-351).

At the factory, the analyzer is first calibrated on the desired gas standard at the specified concentration. Then a measurement is made with isobutylene.

The ppm reading along with the span setting using isobutylene is recorded in the calibration report.

In service, the analyzer calibration can be checked and readjusted if necessary by using this cylinder and regulator as follows:

- a. Connect the analyzer to the regulator and cylinder with a short piece (butt connection) of tubing as shown in Figure 8-1. The calibration gas in the cylinder consists of a mixture of isobutylene and zero air. Isobutylene is nontoxic and safe to use in confined areas. There are no listed exposure levels at any concentration.
The regulator sets and controls the flow rate of gas at a value preset at the factory. This will be about 100 to 200 cc/min.
It is important that the tubing be clean since contaminated tubing will effect the calibration reading. Do not use the cylinder below about 30 psig as readings below that level can deviate up to 10% from the rated value.
Safely discard the disposable cylinder when empty. Do not refill this cylinder.
It is against the law to transport refilled cylinders.
- b. With the SPAN setting and the function switch at the same positions as listed in the Application Data Sheet or Calibration Report, open the valve on the cylinder until a steady reading is obtained.
- c. If the reading is the same as the calibration standard the analyzer calibration for the original species of interest is still correct.
- d. If the reading has changed, adjust the SPAN setting until the reading is the same.
- e. Shut off the cylinder as soon as the reading is established.
- f. Record and maintain this new SPAN setting. Then recalibrate the analyzer on the species of interest as soon as possible.
- g. Whenever the analyzer is recalibrated, it is to be immediately checked with the small cylinder and the reading recorded. This can then be used for later checking in the field.

SECTION 8 cont.

8.3 CALIBRATION WITH ALTERNATE GAS

If a calibration standard with the same trace gas as that to be measured is not available or is hazardous, it is possible to use an alternate calibration gas. In this case, the expected reading for calibration must be compensated for the difference between the two gases. In operation, the meter will then give a direct reading of the gas being measured.

This calibration is illustrated in the following examples:
(PS = Photoionization Sensitivity. See Table 8-14)

a. Given a case in which:

- 1) The trace gas to be measured is Vinyl Chloride
(PS = 5.0)
- 2) The calibration gas to be used is Isobutylene
(PS = 7.0) at a 100 ppm level

What is the ppm reading to be when calibrating to give a direct reading when measuring Vinyl Chloride?

The required reading for calibration will be:

$$\begin{aligned} &= \text{Isobutylene ppm} \times \frac{\text{PS(Isob)}}{\text{PS(Vin Chlor)}} \\ &= 100 \times \frac{7.0}{5.0} \\ &= 140 \text{ ppm} \end{aligned}$$

In this example, using a calibration gas with 100 ppm of Isobutylene, adjust the SPAN control so the meter reads 140 ppm. In operation, the instrument will then give a direct reading of the ppm of Vinyl Chloride.

b. Given a case in which:

- 1) The trace gas to be measured is Benzene (PS = 10.0)
- 2) The calibration gas to be used is Isobutylene
(PS = 7.0) at a level of 100 ppm
- 3) What is the ppm reading to be when calibrating to give a direct reading when measuring Benzene.

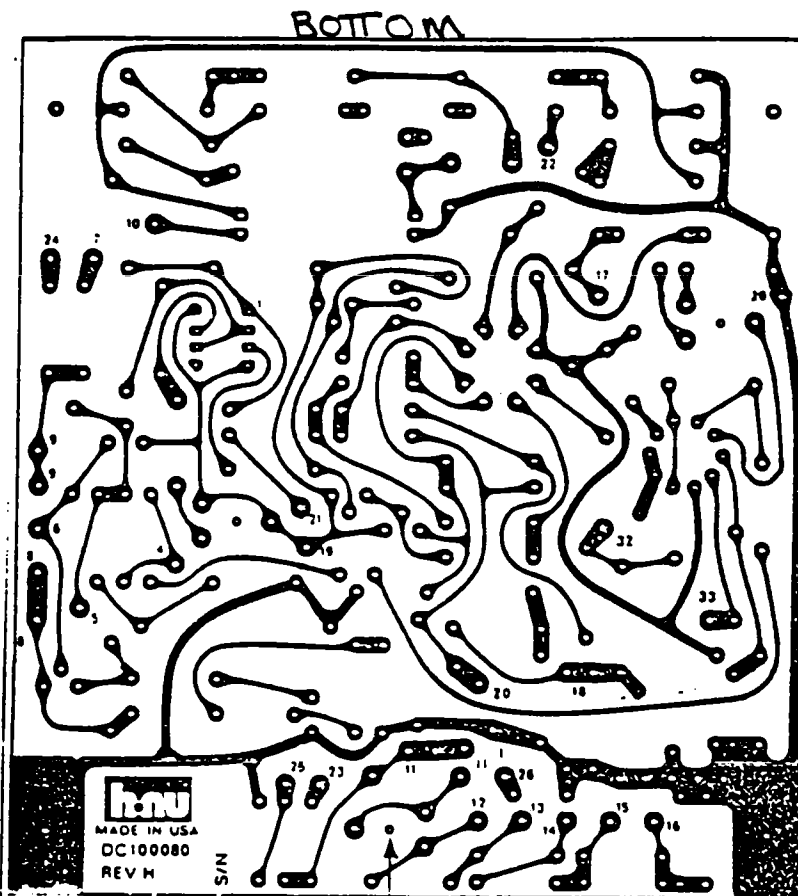


Fig. #86-04B

TOP

GAIN CONTROL POT R48

8-9

h-nu

FIELD SAMPLING PLAN

APPENDIX C

FIELD FORMS



CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

DAILY QUALITY CONTROL REPORT

Site:

Site Location:

Report No:

Date:

Field Team:

Weather: ☐ Bright Sun ☐ Clear ☐ Overcast ☐ Rain ☐ Snow

Temperature: ☐ < 32°F ☐ 32 - 50°F ☐ 51 - 70°F ☐ 71 - 85°F ☐ > 85°F

Wind: ☐ Calm ☐ Breeze ☐ Windy → Direction:

Humidity: ☐ Dry ☐ Moderate ☐ Humid

SAMPLE SUMMARY		EQUIPMENT CALIBRATION					COMMENTS (Deviations from FSP, Problems, etc.)
No. of Samples Collected	Sample Media	Field Instrument	ID Number	Date of Last Calibration	Equipment Functioning Yes No		

Site Manager:

Date:

Date sent to COE IM:



CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of CDMC Dresser Industries Inc.

MAINTENANCE AND CALIBRATION RECORD

Date: _____ Time: _____ (hours)

Employee Name: _____

Equipment Description: _____

Contract/Project: _____

Equipment ID No.: _____

Activity: _____

Equipment Serial No.: _____

MAINTENANCE

Maintenance Performed: _____

Comments: _____

Signature: _____

Date: _____

CALIBRATION/FIELD CHECK

Calibration Standard: _____

Concentration of Standard: _____

Lot No. of Cal. Standard: _____

Expiration Date of Calibration Standard: _____

Pre-Calibration Reading: _____

Post-Calibration Reading: _____

Pre-Field Check Reading: _____

Post-Field Check Reading: _____

Adjustment(s): _____

Calibration: ☐ Passed ☐ Failed

Comments: _____

Signature: _____

Date: _____

HTW DRILLING LOG

HOLE NO

PROJECT

INSPECTOR

SHEET

OF

SHEETS

ELEV

DEPTH

DESCRIPTION OF MATERIALS

FIELD
SCREENING
RESULTS

GEOTECH SAMPLE
OR CORE BOX NO

ANALYTICAL
SAMPLE NO

BLOW
COUNTS

REMARKS

a

b

c

d

e

f

g

h

PROJECT

HOLE NO

HOLE NO

ELEV	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	ANALYTICAL SAMPLE NO.	BLOW COUNTS	REMARKS
a	b	c	d	e	f	g	h

TABLE 1
WELL INTEGRITY CHECKLIST

Well ID _____ Location _____

Inspector _____ Date _____ Time _____

SURFACE INSPECTION

Is any debris or vegetation obstructing the view of or access to the well? If so, describe.

Does the well have an above-grade or flush-mount protective casing? _____

Above-Grade Protective Casings

Is the protective casing straight and sturdy? _____

Are the guard posts straight, loose, or missing? _____

Is the paint on the guard posts and protective casing visible and not severely chipped? _____

What is the condition of the concrete pad? Is it cracked, crumbling, or missing? _____

Is the lock missing or in poor condition? _____

Flush-Mount Protective Casings

Is the manhole cover loose, broken, or missing? _____

Are the bolts used to secure the manhole cover missing or in poor condition? _____

Actual Well

Is the visible portion of the well casing bent, cracked, or missing? _____

Does the well contain a dedicated pump? If so, remove the pump and describe any signs of deterioration.

SUBSURFACE INSPECTION OF THE WELL CASING

What is the diameter of the well? _____ What is the diameter of the bailer used in this well? _____

What type of casing does the well have? _____ What is the depth to water? _____

What is the historical total depth of the monitoring well? _____

What is the current total depth of the monitoring well? _____

Is there any difference between the two total depths? _____

What is the total depth reached by the bailer? _____ Is this comparable to the total depth? _____

Is a measuring point marked on the top of the casing? _____

Is DNAPL present? _____ If so, what is its thickness? _____

General Assessment of the Well _____

DETERMINING WELL INTEGRITY

Purpose: To determine the integrity of a monitoring well by checking the various components of the well.

Procedure: The following procedure should be used to determine and document the integrity of each monitoring well:

1. Integrity determination should begin with a visual inspection of the surface portion of the well, and the area immediately surrounding the well:
 - a. Note whether any debris or vegetation is obstructing the view of or access to the well.
 - b. For a well with an above-ground protective casing, note whether the casing has been bent or moved in any way, whether paint has chipped off the casing, and if the lock is missing or in poor condition.
 - c. For a well with concrete pad and guard posts, note whether the concrete is cracked, crumbled, or missing. Note whether the guard posts are loose or missing and if paint has chipped off the posts.
 - d. For a flush-mounted well, note whether the flush-mounted manhole cover is loose, broken, or missing. Also note whether the bolt(s) securing the manhole cover are missing or in poor condition.
2. Next, the protective-casing cover or manhole cover should be removed to examine the integrity of the well itself. Note whether the visible portion of the well casing is bent, cracked, or missing. If the well contains a dedicated pump, remove the pump, examining and noting whether the discharge lines and pump show signs of deterioration.
3. To check the integrity of the subsurface portion of the well casing, two methods shall be employed:
 - a. First, record the depth of the well from the top of the protective or well casing, whichever is higher. This can be done using a water-level indicator marked off at 0.1-foot intervals. When the measured well depth is compared to historical records, the values will determine if the well casing has moved or formation materials have entered the well.
 - b. Second, lower a decontaminated bailer to the bottom of the well. The bailer should have a diameter just smaller than the diameter of the well. If the bailer becomes lodged before it can reach the bottom of the well, the well casing may be bent or broken.

All downhole equipment shall be decontaminated in the following manner: first wipe the entire length of the equipment (wire, cord, indicator, bailer) with a paper towel soaked in an alconox/ deionized water mixture (soapy water); then wipe the entire length of the equipment with a paper towel soaked in 10% methanol. The simplest and fastest way to decontaminate the equipment can be accomplished by holding the methanol soaked towel around the cord directly below a soapy water towel while a second person winds up the cord.

4. Alternatively, a downhole video camera can be used to assess the integrity of the subsurface portion of the well casing with much greater certainty. The downhole video camera is able to visually detect bent or broken casing, and is able to determine whether the well screen has become plugged with silt or mineral deposits. The downhole video camera shall be decontaminated between monitoring wells.
5. Table 1 is a checklist that should be completed to document conditions of each well.

MISCELLANEOUS MILITARY/CIVIL HTRW PROJECTS
FOR
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

FINAL
QUALITY ASSURANCE PROJECT PLAN

PRE-REMEDIAL DESIGN INVESTIGATION
ATLANTIC WOOD INDUSTRIES, INC. SUPERFUND SITE
PORTSMOUTH, VIRGINIA

CONTRACT NO. DACA31-96-D-0014
DELIVERY ORDER NO. 015

27 January 2000

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

Prepared by:

CDM FEDERAL PROGRAMS CORPORATION
13135 Lee Jackson Memorial Highway
Fairfax, Virginia 22033

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LIST OF ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
AWI	Atlantic Wood Industries
BaPEq	Benzo(a)pyrene equivalents
CDM Federal	CDM Federal Programs Corporation
CLP	Contract Laboratory Program
COC	Chain-of-custody
CQCR	Contractor Quality Control Report
DNAPL	Dense Non-Aqueous Phase Liquid
DCQCR	Daily Chemical Quality Control Report
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LCS/LCSD	Laboratory Control Spike/Laboratory Control Spike Duplicate
LIF	Laser Induced Fluorescence
LIMS	Laboratory Information Management System
mg/kg	milligrams per kilogram
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MS/MSD	Matrix Spike/Matrix Spike Duplicate
ng/L	nanograms per liter
NIST	National Institute of Standards and Technology
PAH	Polynuclear Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCP	Pentachlorophenol
PID	Photoionization Detector
PRDI	Pre-Remedial Design Investigation
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
%R	Percent Recovery
ROD	Record of Decision
RPD	Relative Percent Difference
RRU	Remedial Response Unit
SCAPS	Site Characterization and Analysis Penetrometer System
SOP	Standard Operating Procedure
TAL	Target Analyte List
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

ug/kg	micrograms per kilogram
ug/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
VOCs	Volatile Organic Compounds
°C	degrees Centigrade

1.0 PROJECT DESCRIPTION

The Atlantic Wood Industries (AWI), Inc. Superfund Site is an inactive wood processing and storage facility, which has been used as a possible coal tar refinery, creosote treating plant, pentachlorophenol (PCP) treating plant, and treated lumber storage facility. Inactive wood processing operations and wood storage areas are located on the eastern portion of the site, and treated and untreated wood were stored on the west side of the site. The AWI Superfund Site occupies approximately 47.5 acres of land on the industrialized waterfront area of Portsmouth, Virginia. The site is split into eastern and western portions by the Norfolk and Portsmouth Beltline Railroad and Burtons Point Road.

The U.S. Army Corps of Engineers (USACE) is planning a Pre-Remedial Design Investigation (PRDI) at the AWI Superfund Site. The purpose of the investigation is to define the extent of soil and sediment contamination above the water table that exceeds the 1995 Record of Decision (ROD) cleanup levels and to determine the extent of mobile dense non-aqueous phase liquid (DNAPL) below the water table.

This Quality Assurance Project Plan (QAPP) has been prepared in accordance with the following USACE guidance documents:

- EM 200-1-3 "Requirements for the Preparation of Sampling and Analysis Plans."
- EM 200-1-6 "Chemical Quality Assurance for HTRW Projects" dated 10 October 1997.
- "Shell for Analytical Chemistry Requirements, Version 1.0," dated 2 November 1998.

- Assuring laboratory compliance with the QA Manual via audits, analysis of performance samples, approval of corrective action reports, and conducting seminars to communicate to employees the policies and procedures of the Quality Assurance Manual.
- Obtaining and maintaining all certifications, validations and accreditations required to demonstrate the capabilities and competence of the laboratory to meet marketing and client needs.
- Arranging audits of the laboratory by clients, state regulatory agencies or third party accrediting organizations.
- Approving analytical methods and operations protocol [Standard Operating Procedures (SOPs)] for use throughout the laboratory.
- Investigating and responding to customer inquiries concerning data quality.
- Approving and signing final Quality Control Data Reports.

3.0 DATA QUALITY OBJECTIVES

3.1 BACKGROUND

The primary goals of the PRDI include: (1) define the extent of soil and sediment contamination above the water table that exceed the 1995 ROD cleanup levels, and (2) define the extent of mobile DNAPL below the water table. The general tasks involved in this effort include:

- Preparing a Work Plan (which includes a FSP, QAPP, and Site Safety and Health Plan) that describes PRDI activities.
- Performing the PRDI, which includes a surface geophysical survey, ordnance avoidance, surface and subsurface soil sampling, sediment sampling, Site Characterization and Analysis Penetrometer System (SCAPS) investigation and verification, and existing monitoring well condition survey.
- Preparing a SCAPS Investigation Report.
- Preparing a PRDI Report.

Data quality objectives (DQOs) are qualitative and quantitative goals and limits established for field and laboratory data that provide the means by which data reviewers can assess whether the goals of an investigation have been met. The qualitative objectives provide descriptions of the questions to be answered, the data that must be collected, the methods for collecting data, the analyses required, and the end use of the data.

The qualitative objectives of this project are to:

Objective No.	Qualitative Objective
1	Perform a surface geophysics survey of subsurface areas to locate buried debris, underground utilities, and other objects that may need to be investigated or avoided.
2	Conduct ordnance avoidance for each subsurface sampling location in the Navy leased area.
3	Conduct offsite laboratory analysis for TCL VOCs, PAHs, PCP, dioxins/furans, and TAL metals in surface and subsurface soil samples to define the extent of soil contamination above the water table that exceeds ROD cleanup levels (or risk-based screening levels, as appropriate).
4	Conduct offsite laboratory analysis for PAHs, PCP, dioxins/furans, and TAL metals in sediment samples to define the extent of sediment contamination above the water table that exceeds ROD cleanup levels (or risk-based screening levels, as appropriate).
5	Conduct subsurface testing and onsite screening of DNAPL using the SCAPS laser induced fluorescence (LIF) probe to determine the extent of mobile DNAPL below the water table, and the SCAPS rig to identify the extent and thickness of the Yorktown clay confining unit.
6	Conduct offsite laboratory analysis for PAHs, PCP, and TPH in direct push verification soil samples to evaluate the effects of interference from petroleum compounds at the site to SCAPS LIF readings. These soil samples will also be visually logged to verify SCAPS stratigraphic data.
7	Conduct offsite laboratory analysis of soil classification parameters in select soil samples.
8	Conduct a well condition survey of existing onsite wells on the entire site (including water level readings, well depth measurements, interface probe readings for DNAPL, and completion of a well condition survey form).
9	Develop an analytical database, import laboratory data and other field data, accommodate third party data validation results, and evaluate the data for report preparation.
10	Summarize SCAPS data in a SCAPS Report.
11	Summarize findings in a PRDI Report.

Quantitative DQOs establish numeric limits for acceptable results. The numeric limits aid in establishing levels of confidence in the quality of the data collected as part of the field investigation. The numeric limits are tied directly to the intended end use of the data. Numeric limits include: analytical detection limits, precision and accuracy control limits, QC frequency, and completeness. The quantitative DQOs for all the offsite analyses conducted for this project are listed in Section 3.2 of this QAPP.

ANALYTICAL LEVELS

To ensure that data will be usable for the intended purpose for which they have been collected, analytical levels have been established that define data uses and limitations for field and laboratory data. This section defines analytical levels and indicates the levels appropriate to different data uses.

Data quality has been defined by the U.S. Environmental Protection Agency (EPA) in terms of levels of analytical quality control. This sampling event will involve the use of EPA Screening and Definitive Quality Control Levels. The following is a general description of the levels to be used for this investigation:

- **Screening Level:** Field screening data collected with portable field instruments (such as photoionization detectors [PIDs], pH meters, etc.) are considered to be Screening Level data. These data are used to identify the presence of a target compound or group of compounds, without actually identifying or quantifying the specific compound. Screening Level is normally used for health and safety purposes, but can also be used to identify media or samples that can be subject to further analyses. During this sampling event, Screening Level data will consist of PID readings collected for health and safety monitoring.
- **Definitive Level:** Definitive Level data can be used to characterize and define the extent of contamination. All samples sent to the offsite laboratory will be analyzed and data reported at Definitive Level quality.

3.2 QA OBJECTIVES FOR CHEMICAL DATA MEASUREMENT

3.2.1 PRECISION

Precision is the degree of agreement between repeated measurements of one property using the same method or technique and is presented as a relative percent difference (RPD) according to the equation in Section 9.0. Precision will be calculated by the laboratory from results for laboratory control sample/laboratory control sample duplicates (LCS/LCSDs) and matrix spike/matrix spike duplicates (MS/MSDs) run once per batch. All compounds that will be reported will be used as spike analytes. Field duplicates will also be collected to assess precision. Acceptable control limits for laboratory precision will be those provided in the "Shell for Analytical Chemistry Requirements, Version 1.0," dated 2 November 1998. The quantitation limits are listed in Tables 3-1 through 3-4 and are below the cleanup levels identified in the Record of Decision and listed in Table 3-5.

3.2.2 ACCURACY

Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy is a measure of the bias in a system and is usually presented as the percent recovery (%R) of a sample result. The %R will be calculated on the results for laboratory surrogate compounds (organic analyses only), LCS/LCSDs, and MS/MSDs according to the equation in Section 9.0. Acceptable control limits for laboratory accuracy will be those provided in the "Shell for Analytical Chemistry Requirements, Version 1.0," dated 2 November 1998. The quantitation limits are listed in Tables 3-1 through 3-4 and are below the ROD cleanup levels (Table 3-5).

TABLE 3-1

**ANALYTE QUANTITATION LIMITS FOR
TCL VOCs (EPA 8260B) ANALYSIS**

Compound	Soil/Sediment	Water
	Quant. Limits (ug/kg)	Quant. Limits (ug/l)
Acetone	100	100
Benzene	5	5
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	100	100
Carbon disulfide	5	5
Carbon tetrachloride	5	5
Chlorobenzene	5	5
Chloroethane	10	10
2-Chloroethyl vinyl ether	10	10
Chloroform	5	5
Chloromethane	10	10
Dibromochloromethane	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1-Dichloroethene	5	5
cis-1,2-Dichloroethene	5	5
trans-1,2-Dichloroethene	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
trans-1,3-Dichloropropene	5	5
Ethylbenzene	5	5
2-Hexanone	100	100
Methylene chloride	5	5
4-Methyl-2-pentanone	100	100

TABLE 3-1**ANALYTE QUANTITATION LIMITS FOR
TCL VOCs (EPA 8260B) ANALYSIS (continued)**

Compound	Soil/Sediment	Water
	Quant. Limits (ug/kg)	Quant. Limits (ug/l)
Styrene	5	5
1,1,2,2-Tetrachloroethane	5	5
Tetrachloroethene	5	5
Toluene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
Vinyl acetate	5	5
Vinyl chloride	10	10
Xylenes (total)	10	10

Notes:

Positive results between the instrument detection limit and the quantitation limits will be reported and qualified as estimated "J."
Method detection limits will be conducted and the quantitation limits verified.

TABLE 3-2

**ANALYTE QUANTITATION LIMITS FOR PAHs (EPA 8270C),
PCP (EPA 8270C/8151A), AND TPH (EPA 8015B) ANALYSIS**

Compound	Soil/Sediment	Water
	Quant. Limits (ug/kg)	Quant. Limits (ug/l)
Acenaphthene	330	10
Acenaphthylene	330	10
Anthracene	330	10
Benzo(a)anthracene	330	10
Benzo(a)pyrene	330	10
Benzo(b)fluoranthene	330	10
Benzo(g,h,i)perylene	330	10
Benzo(k)fluoranthene	330	10
Chrysene	330	10
Dibenz(a,h)anthracene	330	10
Fluoranthene	330	10
Fluorene	330	10
Indeno(1,2,3-cd)pyrene	330	10
Naphthalene	330	10
Phenanthrene	330	10
Pyrene	330	10
Pentachlorophenol*	1700 (soil) 400 (sediment)	50
TPH (diesel & gasoline)	20,000	600

*EPA Method 8270C will be used to determine pentachlorophenol concentration in soil and Method 8151A will be used to determine pentachlorophenol concentration in sediment.

Positive results between the instrument detection limit and the quantitation limits will be reported and qualified as estimated "J." Method detection limits will be conducted and the quantitation limits verified.

TABLE 3-3**ANALYTE QUANTITATION LIMITS FOR TAL METALS (EPA 6010B)
INCLUDING MERCURY (EPA 7470A/7471A) ANALYSIS**

Compound	Soil/Sediment	Water
	Quant Limits (mg/kg)	Quant Limits (ug/L)
Aluminum	5	100
Antimony	0.25	5
Arsenic	0.25	5
Barium	0.5	10
Beryllium	0.25	5
Cadmium	0.025	0.5
Calcium	25	500
Chromium	1	20
Cobalt	0.5	10
Copper	0.5	10
Iron	5	100
Lead	0.25	5
Magnesium	5	100
Manganese	0.5	10
Mercury	0.01	0.2
Nickel	1	20
Potassium	5	100
Selenium	0.25	5
Silver	1	20
Sodium	25	500
Thallium	0.1	2
Vanadium	0.5	10
Zinc	1	20

Notes:

Positive results between the instrument detection limit and the quantitation limits will be reported and qualified as estimated "J."
Method detection limits will be conducted and the quantitation limits verified.

TABLE 3-4

**ANALYTE QUANTITATION LIMITS FOR
DIOXINS/FURANS (EPA 8290) ANALYSIS**

Compound	Soil/Sediment	Water
	Quant. Limits (ug/kg)	Quant. Limits (ng/L)
2,3,7,8-TCDD	0.001	0.010
1,2,3,7,8-PeCDD	0.005	0.050
1,2,3,4,7,8-HxCDD	0.005	0.050
1,2,3,6,7,8-HxCDD	0.005	0.050
1,2,3,7,8,9-HxCDD	0.005	0.050
1,2,3,4,6,7,8-HpCDD	0.005	0.050
OCDD	0.010	0.050
2,3,7,8-TCDF	0.001	0.050
1,2,3,7,8-PeCDF	0.005	0.050
2,3,4,7,8-PeCDF	0.005	0.050
1,2,3,4,7,8-HxCDF	0.005	0.050
1,2,3,6,7,8-HxCDF	0.005	0.050
1,2,3,7,8,9-HxCDF	0.005	0.050
2,3,4,6,7,8-HxCDF	0.005	0.050
1,2,3,4,6,7,8-HpCDF	0.005	0.050
1,2,3,4,7,8,9-HpCDF	0.005	0.050
OCDF	0.010	0.100

Notes:

Positive results between the instrument detection limit and the quantitation limits will be reported and qualified as estimated "J."

Method detection limits will be conducted and the quantitation limits verified.

TABLE 3-5

CLEANUP LEVELS IDENTIFIED IN AWI RECORD OF DECISION (mg/kg)

Area	BaPEq^a	Total PAHs	PCP	Arsenic	Copper	Zinc	Dioxins/ Furans
RRU1 - Area 1 Wood Treatment Area East	11	100	3 ^b	150	390	410	0.001
RRU1 - Area 2 Wood Treatment Area West	10	100	2 ^b	76	390	410	0.001
RRU1 - Area 3 Historic Disposal Area	8	100	3 ^b	150	390	410	0.001
RRU1 - Area 4 Wood Storage Yard	6	100	3 ^b	131	390	410	0.001
RRU5 - Area 9 Acetylene Sludge Area	8	100	3 ^b	150	390	410	0.001
Sediments by Area: RRU2 - Area 5, 6, 7 RRU4 - Area 8 (All Sediment Areas)	n/a	25	0.4 ^c	85	390	270	0.001

Notes:

^aBaPEq = benzo(a)pyrene equivalents (represents carcinogenic PAHs)

^bChemical and biological monitoring of sediments must be performed if post-remedial concentrations of PCP exceed 0.4 mg/kg in site soils.

^cThe sediment cleanup level for PCP (0.4 mg/kg) is not expected to be achievable using engineered land treatment, and excavated sediments shall be backfilled with clean sediments. Sediments that are treated to achieve the soil cleanup level for PCP (2 to 3 mg/kg) shall be backfilled as soil. EPA Method 8270C will be used to determine pentachlorophenol concentration in soil and Method 8151A will be used to determine pentachlorophenol concentration in sediment.

RRU - Remedial Response Unit.

3.2.3 REPRESENTATIVENESS

Representativeness is the degree to which the sample data accurately and precisely represents the true value of a characteristic of a population, parameter variations at a sampling point, or an environmental condition intended to be characterized. Representativeness is a qualitative parameter that can be controlled by the proper design and management of the sampling program. Representativeness will be determined by examining trip blanks, rinsate blanks, sample log in and receiving information, and chain-of-custody (COC) records. The blanks aid in determining if the samples contained possible contamination that was not representative of the sample. The sample log in and receiving information and COC records aid in assessing sample integrity.

3.2.4 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

Completeness can be quantified, and the completeness goal for this project is 90% (i.e., $\geq 90\%$).

A sample result is determined to be complete if (1) the correct sample analysis was performed (laboratory completeness); (2) complete records exist for each sample result and the required associated QC sample data was collected (field and laboratory completeness); and (3) the procedures specified in the FSP were implemented and documented (field completeness). If there are any major completeness issues with any specific location, parameter or sample type, these issues will be discussed in the data report.

3.2.5 COMPARABILITY

Where appropriate, the results of analyses obtained may be compared with the results from previous (or future) studies. Comparability is a qualitative measure of the confidence with which one data set can be compared to another. Comparability will be ensured through the use of SOPs

for sampling and field operations and the use of EPA approved analytical methods as presented in the FSP and this QAPP.

When appropriate, the results of analyses may also be compared to cleanup levels. For cleanup level comparability, a goal of 90% has been set. This goal will be achieved if at least 90% of the data are comparable to the cleanup levels (i.e., positive results or quantitation limit at or below the cleanup level).

3.2.6 QUANTITATION LIMITS

Tables 3-1 through 3-4 identify the quantitation limits that the laboratory will achieve for sample analyses. Table 3-5 lists the cleanup levels as identified in the Record of Decision for comparison to quantitation limits.

4.0 SAMPLING LOCATIONS AND PROCEDURES

Sampling locations and procedures for the surface geophysical survey, ordnance avoidance, soil sampling, sediment sampling, SCAPS sampling and testing, and existing monitoring well condition survey are presented in Section 4.0 of the FSP.

5.0 SAMPLE CUSTODY AND HOLDING TIMES

5.1 SAMPLE CUSTODY

A required part of any sampling and analysis program is assuring the integrity of the sample from collection to data reporting. This includes the ability to trace sample possession from the time of collection, through analysis and reporting of results, to final sample disposition. This documentation is referred to as "chain-of-custody" (COC). The components of field COC are discussed in Section 5.0 of the FSP. The components of laboratory COC are described below.

5.1.1 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

A sample is considered to be in custody if it is:

- (1) In the possession of an individual,
- (2) In view of the person after he/she has taken possession, or
- (3) In a secure area or locked vehicle.

Sample custody is initiated at the laboratory by the sample control technician who receives the cooler containing samples. The sample control technician completes the CDM Federal COC record and returns it to CDM Federal. At this time, the sample control technician will check the COC record and sample label to ensure that the record and labels are complete and consistent; the technician will also check the condition of the samples and the temperature of the cooler and will document this information on a cooler receipt or equivalent form. Any discrepancies or problems will be reported to CDM Federal immediately. The sample control technician is responsible for placing the samples in a secure area in an appropriate environment (i.e., refrigeration if necessary) until analysis.

At each transfer within the laboratory, an internal COC record will be completed with each person relinquishing and accepting the samples with their signature, date and time. An intra-laboratory COC record will be completed as necessary. The Laboratory Information Management System (LIMS) maintains the following information for each sample:

- Client name and client code
- Report number
- Number of samples
- Sample identification
- Date received, date test results due
- Date printed
- Priority status
- Tests to be performed
- Appropriate comments.

This information is printed and distributed with the samples during transfer from sample control to the appropriate laboratory department, thereby facilitating intra-laboratory sample integrity. Upon completion of all analyses, an analyst will place the sample into storage, for future disposal at the request of CDM Federal.

5.2 PRESERVATIVES AND HOLDING TIMES

The preservatives and holding times for analysis, and extraction if required, are shown in Tables 5-1 and 5-2. Holding times start on the date of sample collection, and will be adhered to by the laboratory.

TABLE 5-1
SOIL AND SEDIMENT SAMPLE CONTAINERS, PRESERVATIVES,
AND HOLDING TIMES

Parameter	Method	Sample Container ¹	Preservative	Holding Time ²
TCL VOCs	EPA ³ 8260B Soil Prep. EPA 5030B/5035	Three EnCore™ Soil Samplers and one 4-oz. glass jar ⁴	Cool to 4°C	2 days to preservation 14 days to analysis
PAHs and PCP	EPA 8270C/8151A ⁵ Soil Prep. EPA 3550B	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days to extraction 40 days to analysis
TAL Metals	EPA 6010B/7471A Soil Prep. EPA 3050B	8-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	180 days (28 days for mercury)
Dioxins/Furans	EPA 8290 Soil Prep. In Analytical Method	4-oz. widemouth amber glass jar with Teflon-lined closure	Cool to 4°C	30 days to extraction 40 days to analysis
TPH (Diesel Range)	EPA 8015 (modified) Soil Prep. In Analytical Method	4-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days to extraction 40 days to analysis
TPH (Gasoline Range)	EPA 8015 (modified) Soil Prep. In Analytical Method	4-oz. widemouth glass jar with Teflon-lined closure	Cool to 4°C	14 days
Soil Classification	ASTM ⁶ D2487 Soil Prep. In Analytical Method	Two 16-oz. widemouth glass jars	None	None

Notes:

¹Sample containers will be packed full to minimize headspace. Double sample volume may be required for soil MS/MSD analyses.

²Holding time begins at the time of sample collection.

³U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

⁴The 4-oz. glass jar is a dry weight sample (collected as a typical VOA sample) and is sent to the laboratory for dry weight analysis.

⁵EPA Method 8270C will be used to determine pentachlorophenol concentrations in soil and Method 8151A will be used to determine pentachlorophenol concentration in sediment.

⁶American Society for Testing and Materials, Annual Book of ASTM Standards, Current Edition.

TABLE 5-2
WATER SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Method	Sample Container	Preservative	Holding Time ¹
TCL VOCs	EPA ² 8260B Water Prep. EPA 5030B	Three 40-mL glass vials with Teflon-lined septum	HCL to pH <2 Cool to 4°C	14 days
PAHs and PCP	EPA 8270C Water Prep. EPA 3510C/3520C	Two 1-L amber glass jars with Teflon-lined closure	Cool to 4°C	7 days to extraction 40 days to analysis
TAL Metals	EPA 6010A/7470A Water Prep. EPA 3010A	1-L polyethylene with polyethylene closure	HNO ₃ to pH <2 Cool to 4°C	180 days (28 days for mercury)
Dioxins/Furans	EPA 8290 Water Prep. In Analytical Method	Two 1-L amber glass jar with Teflon-lined closure	Cool to 4°C	30 days to extraction 40 days to analysis
TPH (Diesel Range)	EPA 8015 (modified) Water Prep. In Analytical Method	1-L amber glass jar with Teflon-lined closure	Cool to 4°C	7 days to extraction 40 days to analysis
TPH (Gasoline Range)	EPA 8015 (modified) Water Prep. In Analytical Method	Two 40-ml glass vials with Teflon-lined septum	HCL to pH <2 Cool to 4°C	14 days

Notes:

¹Holding time begins at the time of sample collection.

²U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

6.0 ANALYTICAL PROCEDURES

6.1 ONSITE SCAPS SCREENING

Up to 300 locations will be screened for the presence of DNAPL by USACE using the SCAPS rig laser induced fluorescence probe. The screening detection limit will be determined in the field. Details on the procedures for SCAPS sample collection and analysis are presented in Section 4.3.1.1.4 of the FSP.

6.2 OFFSITE LABORATORY ANALYSIS

Soil and sediment samples will be collected at designated depths and sent for offsite analysis by EPA Test Methods for the Evaluating Solid Waste, Physical/ Chemical Methods (SW-846). Surface and subsurface soil samples will be analyzed for TCL VOCs (EPA 8260B), PAHs and PCP (EPA 8270C), TAL metals (EPA 6010B/7471A), and dioxins/furans (EPA 8290). Sediment samples will be analyzed for PAHs and PCP (EPA 8270C/8151A), TAL metals (EPA 6010B/7471A) and dioxins/furans (EPA 8290). The AWI ROD contains cleanup levels for only three of the TAL metals (arsenic, copper, and zinc), yet all TAL metals will be analyzed and reported. This is being conducted for potential future interest in metal contamination at the site.

In addition, verification samples will be collected at SCAPS soil sampling locations at selected depths. These samples will be sent for offsite analysis of PAHs and PCP (EPA 8270C) and TPH (EPA 8015 Modified, diesel and gasoline range) to verify SCAPS screening measurements. Select samples will also be analyzed for soil classification by American Society for Testing and Materials (ASTM) Method D2487. A summary of the number of soil, sediment, and QC samples is provided in Tables 6-1 and 6-2. The QA manuals for any analytical laboratory used for this project will be available to CDM Federal and USACE personnel.

TABLE 6-1
SUMMARY OF ANALYTICAL PROCEDURES FOR SOIL SAMPLES

Analysis Type	TCL VOCs (EPA ¹ 8260B)	PAHs & PCP (EPA 8270C)	TAL Metals (EPA 6010B/7471 A Series)	Dioxin/Furans (EPA 8290)	TPH ² (EPA 8015 Mod)	Soil Characteristics (ASTM ³ D2487)
Soil (West Side)	34	334	264	80	--	--
Soil (East Side)	32	460	336	64	--	--
SCAPS Verification	--	80	--	--	80	5
Rinsate Blanks	15	80	80	15	8	--
Source Water Blanks	6	6	6	6	6	--
Trip Blanks	30	--	--	--	8	--
Duplicates	4	44	32	9	4	1
MS/MSD (Soil)	10	88	64	9	4	--
MS/MSD (Water Blanks)	6	12	4	1	1	--
MS/MSD (Duplicates)	7	5	3	1	1	--
Totals	144	1109	789	185	112	6

Notes:

¹U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Current Edition.

²TPH - Total Petroleum Hydrocarbons (diesel and gasoline range).

³ASTM - American Society for Testing and Materials, Current Edition (soil classification, particle size distribution, liquid limit and plasticity index).

Rinsate Blanks - Analyzed for same parameters to be analyzed that day (estimate 5 per week for PAHs and PCP, 2 per week for VOCs, and 1 per week for Dioxins/Furans and TPH).

Source Water Blanks - Tap water sample collected 1 per month, and ASTM Type II water sample collected 1 per batch (estimate 2 batches).

Trip Blanks - 1 per cooler containing VOC soil samples (estimate 2 per week) and TPH (gasoline range) samples (estimate 1 per week during SCAPS verification).

Duplicates - Analyzed at 5% of environmental samples and will be submitted to a separate laboratory.

MS/MSD - Analyzed at 5% of environmental samples from each matrix and distributed throughout the sampling time period.

TABLE 6-2
SUMMARY OF ANALYTICAL PROCEDURES FOR SEDIMENT SAMPLES

Analysis Type	PAHs & PCP (EPA¹ 8270C/8151A)	TAL Metals (EPA 6010B/7471A)	Dioxin/Furans (EPA 8290)
Sediment (West Side)	12	12	6
Sediment (East Side)	13	13	7
Rinsate Blanks	1	1	1
Duplicates	2	2	1
MS/MSD (sediment)	2	2	2
MS/MSD (duplicates)	1	1	1
Totals	31	31	18

Notes:

¹U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods (SW-846), Current Edition.

Rinsate Blanks - Analyzed for same parameters to be analyzed that day (estimate 5 per week for PAHs and PCP, and 1 per week for Dioxins/Furans).

Duplicates - Analyzed at 5% of environmental samples and will be submitted to separate laboratory.

MS/MSD - Analyzed at 5% of environmental samples from each matrix and distributed throughout the sampling time period.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

All field and laboratory equipment used during this project will be operated, maintained, calibrated, and standardized in accordance with methods and frequencies described in the FSP (Sections 4.1.2.3, 4.3.2.1.1, and 4.3.2.3) and the laboratory methods. Additional information on laboratory calibrations procedures and frequency are described below.

7.1 ANALYTICAL SUPPORT AREAS

Calibration of balances, refrigerators, freezers, water supply system(s) and reagents/standards is critical to the generation of quality data. The laboratory will continuously monitor the quality of reagents and standard solutions through a series of well-documented procedures. Calibration standards will be traceable to the National Institute of Standards and Technology (NIST) or other nationally recognized sources whenever possible. Calibrations of balances should be conducted annually and be well documented. All refrigerators will be monitored to maintain temperatures between 2 and 6° C. The water supply system will be required to achieve ASTM Type II water quality.

7.2 LABORATORY INSTRUMENTS

Calibration of laboratory instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established quantitation limits. Each instrument will be calibrated with standard solutions appropriate to the type of instrument and linear range established within the analytical methods. USACE requires that all reported analytes are to be bracketed by an established calibration curve and that an initial 5-point calibration curve be run (USACE, 1994). USACE also requires that all batches of samples analyzed be bracketed by appropriate calibration verification standards. To avoid qualifications of data below the low level standard but above the instrument detection limit, the laboratory will analyze an additional low standard at or near the quantitation limits listed in Tables 3-1 through 3-4.

8.0 INTERNAL QC CHECKS

The overall QA objective is to implement QC procedures during laboratory analysis and reporting that will provide data to the degree of quality consistent with their intended use. Internal QC checks are used to determine if analytical operations are in control (batch QC), as well as the effect sample matrix may have on data being generated (matrix QC). The internal QC checks required for data generated in this PRDI are discussed below.

8.1 BATCH QC

Samples will be extracted in batches that do not exceed 20 samples per batch. Each batch has the following QC samples associated with it: (1) method blanks to assess the level of background interference or contamination from the analytical system; (2) LCS/LCSDs which are prepared from standard solutions separate from the calibration standards and compared against control limits; and (3) other QC samples as detailed within the analytical methods.

8.2 MATRIX SPECIFIC QC

Matrix-specific QC samples include MS/MSD samples collected by the field program and surrogates spiked by the laboratory into environmental samples. The required frequency of these sample types is established in the analytical method.

When MS recoveries are outside control limits, reanalysis of the MS sample extract/digestate is required for the affected parameters. If the reanalysis results are still not within acceptable control limits, then a dilution of the spiked (and unspiked) extracts/digestates and reanalysis may be performed to document the presence or absence of matrix effects. Results are reported (dilution corrected) if within control limits. If more than an acceptable number of surrogate recoveries are outside control limits, then reextraction and reanalysis are required. If still outside control limits, all surrogate spike recovery results must be summarized and a written explanation of actions taken

must be included in the case narrative. Other corrective actions may be taken including cleanup for SVOCs, method of standard addition for metals, etc.

9.0 CALCULATION OF DATA QUALITY INDICATORS

Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) parameters are commonly used as indicators of data quality. PARCC goals are established to aid in determining data quality. The PARCC parameters are defined below and will be compared to the quantitative DQOs identified in Section 3.2.

9.1 PRECISION

Precision is the degree of agreement between repeated measurements of one property using the same method or technique. Precision will be calculated on the results for LCS/LCSD pairs, MS/MSD pairs and QA split sample pairs. Precision will be estimated using the relative percent difference calculated by the following equation:

$$RPD = \frac{100 (D_1 - D_2)}{(D_1 + D_2)/2}$$

where: D_1 = the larger of the two values

D_2 = the smaller of the two values

9.2 ACCURACY

Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy will be determined using MS samples and laboratory surrogate results using the following equation:

$$\text{Percent Recovery (\%R)} = 100 \times \frac{(\text{Measured Value})}{(\text{True Value})}$$

9.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal circumstances. The following formula will be used to calculate completeness:

$$C = 100 \frac{A}{T}$$

where C = percent completeness

A = actual number of measurements received, including QC results

T = total number of measurements

Completeness calculations will consider matrix, site location, and analytical parameter issues.

9.4 REPRESENTATIVENESS AND COMPARABILITY

Representativeness is the degree to which the sample data accurately and precisely represents the true value of a characteristic of a population, parameter variations at a sampling point, or an environmental condition intended to be characterized. Representativeness is a qualitative parameter that will be controlled by proper design and management of the sampling program. Representativeness will be achieved through careful informed selection of sampling sites, selection of testing parameters and methods that adequately define and characterize the extent of potential contamination, and the proper collection and handling of samples to avoid interferences and prevent analyte loss.

Comparability is a qualitative measure of the confidence with which one data set can be compared to another. Comparability will be ensured through the use of SOPs for sampling and field operations, and EPA approved analytical procedures as presented in the FSP and this QAPP.

When appropriate, the results of analyses may be also compared to cleanup levels. For cleanup level comparability, a goal of 90% was set. This goal will be achieved if at least 90% of the data are comparable to the action levels (i.e., positive results or quantitation limit at or below the action level).

9.5 METHOD DETECTION LIMITS

Detection limits vary with analytical method, matrix type, and concentration of contaminants. The detection limits provided are only goals for the samples collected at the site. Actual detection limits may be higher due to matrix interference, sample dilutions, etc. The laboratory will, at a minimum, perform method detection limit studies during initial method setups, and whenever the basic chemistry of the procedures is changed.

10.0 CORRECTIVE ACTIONS

Corrective actions must be implemented when laboratory QA specifications are not met. The laboratory QA plan provides systematic procedures which will be implemented to resolve problems and restore proper functioning to the analytical system.

10.1 INCOMING SAMPLES

The conditions of samples and sample coolers are documented upon receipt by the laboratory as described in Section 5.1.1. Problems noted during sample receipt, such as cooler temperature excursions or broken sample bottles, are documented on the appropriate form and CDM Federal will be notified immediately. CDM Federal will determine the requirement for resampling at that time. All corrective actions will be thoroughly documented by both CDM Federal and the laboratory.

10.2 SAMPLE HOLDING TIMES

If sample analyses were not extracted/digested and/or analyzed within the appropriate method holding time (see Tables 5-1 and 5-2), CDM Federal will be notified immediately for problem resolution. CDM Federal will consider the number of days outside holding times in evaluating the impact of missed holding times. All corrective actions will be thoroughly documented by both CDM Federal and the laboratory.

10.3 INSTRUMENT CALIBRATION

Laboratory sample analysis will not proceed until all initial calibrations meet the appropriate method and internal QC requirements. All calibrations must meet method time requirements or recalibration must be performed. All continuing calibrations that do not meet method requirements will result in a review of the calibration, rerun of the appropriate calibration

standards, and if necessary, reanalysis of all samples affected back to the previous acceptable calibration check.

10.4 PRACTICAL QUANTITATION LIMITS

Appropriate sample cleanup procedures will be employed to attempt to achieve the practical quantitation limits specified in Tables 3-1 through 3-4. If difficulties arise in achieving the quantitation limits due to a particular sample matrix, the laboratory will notify CDM Federal for problem resolution. Any dilutions made will be documented in a case narrative along with the revised practical quantitation limits.

10.5 METHOD QC

The laboratory will be responsible for analyzing the required method blanks, preparation blanks, MS/MSDs, LCS/LCSDs, surrogates and other method-specified QC samples as specified in the analytical method. Failure of method-required QC will result in reanalysis of the samples within holding times. Section 8.0 of this QAPP outlines the procedures in the event that method QC is out of control. CDM Federal will be notified as soon as possible to discuss possible corrective actions should unusually difficult sample matrices be encountered.

10.6 CALCULATION ERRORS

Data reports will be reissued if calculation or reporting errors are noted. The case narrative will clearly state the reason(s) for reissuance of a data package.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

To ensure that data management activities provide an accurate and controlled flow of data generated by the laboratory, it is important that the following data handling and reporting steps be defined and implemented.

11.1 DATA REDUCTION

Field program data will be produced through visual observation, direct-reading instrumentation, measuring devices, and performance of chemical analyses. All field activities, direct-reading instruments and measuring devices will be used in accordance with the SOPs and manufacturer's instructions referenced in the FSP. Laboratory analysis and reduction of laboratory measurements (i.e., laboratory calculations) will be performed in accordance with the analytical method.

11.2 DATA REVIEW

The analyst who generates the analytical data has the primary responsibility for the correctness and completeness of the data. The review will, at a minimum, ensure that: (1) sample preparation information is correct and complete; (2) analysis information is correct and complete; (3) appropriate SOPs have been followed; (4) analytical results are correct and complete; (5) QC samples are within established control limits; (6) blanks and LCSs are within established control limits; (7) special sample preparation and analytical requirements have been met; (8) calibration verifications are within established control limits; and (9) documentation is complete. The laboratory supervisor is responsible for performing an independent review, and the laboratory QA officer is responsible for performing a total overview of the sample data packages.

CDM Federal will also briefly screen each sample data package to ensure that the following conditions are met: (1) analytical results provided correspond to the analyses requested on the

COC record; (2) holding times were met; (3) none of the data were rejected; (4) quantitation limits were achieved; and (5) correct sample identification numbers were used in the data packages.

11.3 DATA VALIDATION

USACE, Baltimore District will perform data validation in accordance with EPA Region III “Modifications to the National Functional Guidelines for Data Review.” The results of data validation findings will be incorporated into the analytical database.

11.4 DATA REPORTING

The analytical laboratory will provide a sample data package containing sample results and summaries of laboratory QC results for each sample delivery group in compliance with the Shell. At a minimum, the sample data packages will contain:

- Information on Contract Laboratory Program (CLP) Form I.
- Quantitation limits achieved for all sample analyses.
- Control limits for surrogates, MS/MSDs, LCSs, and laboratory duplicates.
- Flags where these QC samples are outside control limits.
- RPDs on laboratory duplicates, LCS/LCSD pairs, and MS/MSD pairs.
- Relative standard deviations and percent differences for initial and continuing calibration verifications, respectively.
- Flags on out of control conditions such as cooler temperature and sample preservation.
- Case narrative explaining dilutions, reextractions, reanalyses, and other analytical problems.

The sample data packages must also contain a table linking samples with their corresponding QC samples. CDM Federal will be responsible for delivering the data packages to USACE for data validation.

All field logbooks, field forms and sample data packages collected for this project will be kept in a secure location in the CDM Federal Office in Fairfax, Virginia. The Site Coordinator will be responsible for the control of this information.

11.5 LABORATORY TURNAROUND TIME

Turnaround time will be 30 days for standard delivery from the time of sample receipt for the vast majority of laboratory analyses conducted. Expedited turnaround is planned for one-half of the SCAPS verification soil samples.

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance is required for all field and laboratory equipment used throughout this PRDI. Preventive maintenance includes routine maintenance checks on equipment and maintenance of a supply of critical spare parts to minimize equipment downtime. Specific field equipment preventive maintenance practices, frequency and spare parts are described in the manufacturer's instructions that are supplied with each piece of equipment.

All maintenance of laboratory equipment will be recorded in maintenance logs. The laboratory will also maintain an adequate inventory of spare parts and consumables to prevent downtime as a result of minor problems.

13.0 PERFORMANCE AND SYSTEM AUDITS

Internal audits will be performed on a periodic basis and are the responsibility of the CDM Federal QA Director. Internal system and performance audits will be conducted on a periodic basis with the frequency increased if problems are discovered. Two field audits are planned for this PRDI. All audits will be in accordance with the CDM Federal Quality Assurance Manual.

Following an audit, the auditor or designated staff will develop an audit report that summarizes the audit findings, including areas found to be in non-conformance (if any) and the proposed corrective actions.

External oversight audits may be performed by the USACE at the discretion of the USACE. These audits may or may not be conducted after prior notification to CDM Federal. External audit reports, including recommended corrective actions, will be the responsibility of the USACE. The offsite analytical laboratories will be subject to audits in accordance with established USACE protocol.

14.0 QA/QC REPORTS TO MANAGEMENT

QC reports to management include the Daily Chemical Quality Control Reports (DCQCRs) submitted by CDM Federal to USACE during the field program (discussed in Section 9.0 of the FSP), Quality Control Summary Reports (QCSRs) which summarize the DCQCRs (discussed in Section 9.0 of the FSP), laboratory monthly progress reports, and audit reports (discussed in Section 13.0 of this QAPP).

Each analytical laboratory performing sample analyses will submit a Laboratory Progress Report to the CDM Federal project manager by the 15th of the month following each month in which work is performed. This report will be forwarded to the USACE Design Manager.

QA reporting activities to management will also be generated by the QA Coordinator and QA Specialist, which includes periodic staff QA reports that summarize QA activities conducted during the reporting period, system and performance audits (internal and external) conducted, quality problems identified, and corrective action initiated.

Reports that present measurement data generated during the work assignment require a QA section addressing the quality of the data and its limitations. Each QA section will address at a minimum:

- Precision, accuracy and completeness achieved for reported measurement data in relation to the goals for these parameters.
- Results of performance or system audits of measurement work.
- Quality problems found and corrective actions taken.
- Deviations from the FSP and QAPP.

All deliverables produced for this project will be subject to at least the following three QC reviews:

- Technical review will be performed by senior professionals who have not been involved in project management or data collection activities.
- QA review will be conducted by the QA staff to ensure that data have been reported accurately.
- Final review will be performed by the Project Manager to ensure that the document addresses all contractual requirements.

All reviews will be documented and kept in the designated project files.

REFERENCES

American Society for Testing and Materials (ASTM), Annual Book of Standards, Current Edition.

CDM Federal Programs Corporation (CDM Federal), Quality Assurance Manual, 1995.

U.S. Army Corps of Engineers (USACE), Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, September 1994.

USACE, Chemical Quality Assurance for HTRW Projects, EM 200-1-6, 10 October 1997.

USACE, Shell for Analytical Chemistry Requirements, Version 1.0, 2 November 1998.

U.S. Environmental Protection Agency (EPA), Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Current Edition.

MISCELLANEOUS MILITARY/CIVIL HTRW PROJECTS
FOR
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

FINAL
SITE SAFETY AND HEALTH PLAN

PRE-REMEDIAL DESIGN INVESTIGATION
ATLANTIC WOOD INDUSTRIES, INC. SUPERFUND SITE
PORTSMOUTH, VIRGINIA

CONTRACT NO. DACA31-96-D-0014
DELIVERY ORDER NO. 015

27 January 2000

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

Prepared by:

CDM FEDERAL PROGRAMS CORPORATION
13135 Lee Jackson Memorial Highway, Suite 200
Fairfax, Virginia 22033

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APPENDICES

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INTRODUCTION

This Site Safety and Health Plan (SSHP), in combination with the CDM Federal Programs Corporation (CDM Federal) Corporate Health and Safety Program Manual, adheres to the requirements of U.S. Army Corps of Engineer (USACE) documents: EM-385-1-1, *Safety and Health Requirements Manual* and ER 385-1-92, Appendix B, *Safety and Health Elements for HTRW and OEW Documents*. Portions of the requirements in the USACE documents that are contained in the CDM Federal Corporate Health and Safety Program Manual include the following:

- Section 2 - Health and Safety Organization
- Section 3 - Health and Safety Training (addresses staff training and qualifications)
- Section 4 - Medical Surveillance Program
- Section 5 - Injury and Illness Prevention (addresses accident prevention plans)
- Section 8 - Confined Space Entry Guidelines (not required for this project)
- Section 11 - Relevant Construction Industry Standards and Standard Site Procedures (addresses standard safety operating procedures and engineering controls)

Radiation protection will not be required for this project at this point, however a radiation screening program (Appendix C) will be implemented. In addition, OSHA Form 200 which provides a record of accidents will be maintained at CDM Federal's Fairfax, Virginia office.

CDM Federal will be conducting Pre-Remedial Design Investigation (PRDI) activities at the Atlantic Wood Industries (AWI), Inc. Superfund Site in Portsmouth, Virginia. Specific activities included in the PRDI are surface geophysical survey, ordnance avoidance, soil and sediment sampling above the water table, subsurface investigation for delineation of dense non-aqueous phase liquid (DNAPL) using a Site Characterization and Analysis Penetrometer System (SCAPS), soil sampling for verification of SCAPS data, and a condition survey of existing wells.

HEALTH AND SAFETY ROLES AND RESPONSIBILITIES

Corporate Health & Safety Manager (CHSM)

The Corporate Health & Safety Manager (CHSM) oversees all aspects of health and safety involving this project. Charles Myers, CIH, is the CDM Federal CHSM. The CHSM has the following duties and responsibilities:

- Approve and maintain the SSHP.
- Implement, enforce, and oversee the SSHP.
- Enforce the SSHP requirements in subcontractor procurement efforts.
- Ensure all employees are trained in site specific hazards.
- Supervise the activities of the Site Health and Safety Officer (SHSO) in his or her performance of health and safety activities.
- Develop standard work site health and safety practices.
- Maintain heat and cold stress monitoring procedures (Appendix B) and personal protective equipment (PPE) requirements for on site personnel.
- Develop additional health and safety procedures as necessary.

In the event of a reportable accident, the USACE Design Manager will be notified as soon as possible via telephone by the CDM Federal Project Manager. The CHSM will complete the ENG Form 3394 (Appendix D). The ENG Form 3394 will be submitted to the USACE Design Manager, along with other appropriate documentation concerning the accident within 24 hours.

Project Manager (PM)

The Project Manager (PM) is responsible for all elements of CDM Federal's performance under this project. Joan Knapp is the CDM Federal PM. The PM has the following duties and responsibilities related to site safety and health:

- Ensure that the SHSO has all plans, equipment, procedures, and other support necessary to perform his responsibilities.
- Assign project staff that are trained in site-specific hazards.
- Ensure all project staff have reviewed and understand the SSHP.

In the event of a reportable accident, the CDM Federal PM will notify the USACE Design Manager by telephone as soon as possible.

Site Health and Safety Officer

The Site Health and Safety Officer reports directly to the CHSM with respect to health and safety concerns involving this project. Mr. Dean Costello will be the SHSO. The SHSO has the following duties and responsibilities:

- Implement and enforce the SSHP.
- Conduct site safety checks.
- Perform air monitoring in support of site activities.
- Enforce the SSHP for subcontractor tasks.
- Assist in the training of employees assigned to the site.
- Conduct on site "Field Safety and Health Meetings."
- Enforce the use of proper PPE for each appropriate work zone and work task.
- Ensure all personnel have current medical releases, respirator fit tests (if applicable), first aid training, and 40-hour Hazardous Waste Operations training, to include annual refreshers.
- Designate and enforce the observance of support, contamination reduction, and exclusion zones for each work zone and task, when applicable.
- Supervise the personnel and equipment log-in/log-out records.
- Implement heat or cold stress monitoring procedures.
- Be able to perform immediate first aid if necessary and notify appropriate authorities in emergencies.
- Perform additional tasks as necessary to ensure the health and safety of employees and subcontractors.
- Ensure that copies of the SSHP and the CDM Federal Corporate Health and Safety Program Manual are available at the site and are followed for all project activities.

Project Staff

The Project Staff are responsible for conducting project activities in compliance with the SSHP, and will report to the SHSO for all site safety and health issues.

DECONTAMINATION APPROACH

Based on the PPE required for the DPT surface and subsurface soil sampling, and sediment sampling, a project decontamination area will not be required for the primary PPE that is listed on page 7 of the SSHP Form. However, should it be necessary to upgrade to Level C protection, then a project decontamination area will be defined for all necessary activities. The exact location of the exclusion zone, contamination reduction zone, and support zone will be selected in the field.

REFERENCES

29 CFR 1910.120, Department of Labor, Occupational Safety and Health Standards, Hazardous Waste Operations and Emergency Response.

CDM Federal Corporate Health and Safety Program Manual, March 1995.

EM-385-1-1, U.S. Army Corps of Engineers, Safety and Health Requirements Manual, October 1992.

ER 385-1-92, U.S. Army Corps of Engineers, Appendix B, Safety and Health Elements for HTRW and OEW Documents, 18 March 1994.

SITE SAFETY AND HEALTH PLAN FORM

CDM FEDERAL PROGRAMS CORPORATION

DECONTAMINATION PROCEDURES

Personalized Decontamination

Summarize below and/or attach diagram; discuss use of work zones.

Respirators will be selected, used, decontaminated, and stored in accordance with one CDM HASM as based on OSHA 1910.134

The personal decontamination station will move from location to location based on work site.

Wash hands and face if necessary with soap and water upon doffing personal protective equipment.

Wash well before hand-to-mouth contact is made. Workers will remove protective clothing in this order:

- equipment drop
- hard hat
- boot covers
- outer gloves
- Tyvek
- respirator (if used)
- inner gloves
- face and hand wash

WASH HANDS AND FACE PRIOR TO ANY INGESTION OF FOOD OR LIQUIDS.

() Not Needed

Sampling Equipment Decontamination

Summarize below and/or attach diagram; discuss use of work zones.

All sampling equipment will be thoroughly decontaminated between samples with liquinox, water, and rinsing.

These tools are decontaminated between use at each sampling location by a six step cleaning process. These steps are:

1. Phosphate-free detergent wash.
2. Rinse with clean, potable water.
3. Rinse with ultra-pure 10% nitric acid (when sampling for metals analysis).
4. Rinse with ASTM Type II water.
5. Rinse with isopropanol.
4. Rinse with ASTM Type II distilled water.
6. Air dry.

() Not Needed

Heavy Equipment Decontamination

Summarize below and/or attach diagram; discuss use of work zones.

All down-hole equipment and tool parts that contact soil are constructed of heavy gauge steel and have no natural or synthetic components that could absorb and retain soil-borne organic contaminants.

All drilling equipment (downhole) and any other large equipment in the construction zone will be washed with a high pressure hot water cleaner prior to first use, between mobilization to each new borehole, and prior to leaving the site after the final borehole is drilled.

() Not Needed

Containment and Disposal Method

Personal protective equipment will be doubled-bagged and placed in a dumpster for disposal in a minimum technology Subtitle D disposal facility.

Containment and Disposal Method

Disposable sampling equipment and sampling derived wastes will be containerized and disposed of off-site in accordance with the IDW section of the project Work Plan.

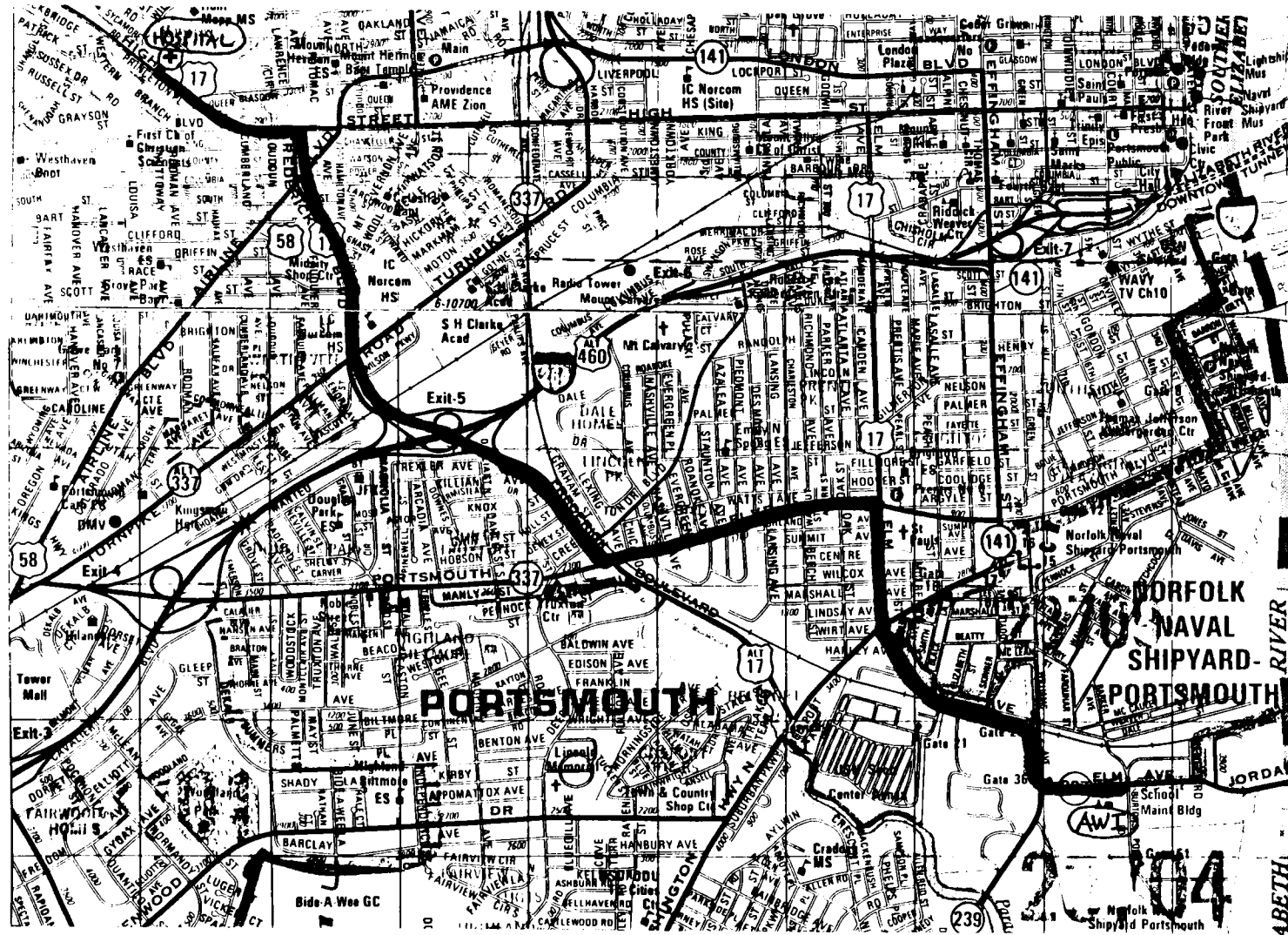
Containment and Disposal Method

Decontamination derived wastes will be containerized and disposed of off-site in accordance with the IDW section of the project Work Plan.

SITE SAFETY AND HEALTH PLAN FORM
CDM FEDERAL PROGRAMS CORPORATION

EMERGENCY CONTACTS			EMERGENCY CONTACTS	NAME	PHONE
Site Telephone	To be determined		Health and Safety Manager	Chuck Myers	1-703-968-0900
EPA Release Report No.	1-215-814-9016		Project Manager	Joan Knapp	1-703-968-0900
CDM 24-Hour Emergency	1-703-754-0700	Chuck Myers (home)	Health & Safety Coordinator	Dean Costello	1-703-968-0900
Facility Management (AWI)	To be determined		Client Contact	Ed Yakuchev	1-410-962-6267
Subcontractors	To be determined	(Geophysical Survey)	Other (specify)		
	To be determined	(Ordnance Avoidance)	Environmental Agency	EPA Region III	1-215-814-5000
	To be determined	(Direct Push)	State Spill Number	VA Release Office	1-800-468-8892
Other (specify)			Fire Department	Shipyard Fire Dept.	1-757-396-3335
CONTINGENCY PLANS Summarize below: Evacuate site if any unexpected hazardous conditions are encountered. The "buddy system" will be employed for all work being done. Site staff, if evacuated, will congregate upwind of the site in a predesignated area (to be announced at the daily health and safety meeting). If a work team observes hazards for which they have not been prepared, they will withdraw from the area and call the CDM Federal CHSM or the local Health and Safety Coordinator for guidance. Solo CDM Federal representatives will not enter or remain in a work area unless accompanied by subcontractor or facility personnel. Without regard to monitoring instrument reading, CDM Federal personnel will leave site and upgrade their level of protection if they experience any physical symptoms listed in the Health and Safety Plan.			Police Department	Shipyard Security Office	1-757-396-5111
			State Police	VA State Police	1-757-494-2434
			Health Department	Chesapeake Health Dept.	1-757-382-8600
			Poison Control Center	VA Poison Center	1-800-552-6337
			Occupational Physician	Dr. Thomas Winters	1-800-350-4511
			MEDICAL EMERGENCY		
HEALTH AND SAFETY PLAN APPROVALS			Hospital Name:	Maryview Hospital	1-757-398-2200
Prepared by: <i>David S. Ly</i> Date: <i>10/8/99</i>			Hospital Address:		36 High Street, Portsmouth
HSM Signature: <i>Jo Knapp for Charles Myers</i> Date: <i>10/8/99</i>			Name of Contact at Hospital:		
			Name of 24-Hour Ambulance:		Shipyard Emergency 1-757-396-3333
			Route to Hospital (Attach map with route to hospital)		
			From office parking lot, turn left onto Elm Ave. Turn left onto Portsmouth Blvd. Take right onto Frederick Blvd., and continue on Frederick until it dead-ends. Make a left onto High St., the hospital is on the right at the first light.		
			Distance to Hospital:		Approximately 5 miles

THIS PAGE RESERVED FOR HOSPITAL ROUTE MAP



SITE SAFETY AND HEALTH PLAN FORM**CDM FEDERAL PROGRAMS CORPORATION**

The following personnel have read and fully understand the contents of this Site Safety and Health Plan and further agree to all requirements contained herein.

Name

Affiliation

Date

Signature

APPENDIX A
DRILLING SAFETY MANAGEMENT

TABLE 1
CDM Federal
Activity Hazard Analysis
Mobilization/Demobilization

<i>Principal Steps</i>	<i>Potential Hazards</i>	<i>Recommended Controls</i>
1. Mobilization of equipment and supplies	Heavy Lifting	<p>Use proper lifting techniques, size up the load, use teamwork, never twist or turn when lifting.</p> <p>Where Level D personal protective equipment, including steel toed/shank work boots.</p> <p>Objects greater than 60 lbs. require assistance or use of a mechanical lifting device.</p>
	Slips, Trips, Falls	<p>Tripping hazards will be identified and remedied by implementation of engineering controls, such as use of barrier tape or snow fence.</p> <p>Good housekeeping procedures.</p>
	Faulty/Damaged Equipment	<p>Continual inspection of work areas.</p> <p>Equipment will be inspected upon arrival and at the beginning of each shift.</p> <p>Equipment to be inspected by competent mechanic and certified to be in safe operating conditions</p>
2. Installation of Temporary Support Facilities	Equipment Operators	<p>Equipment will be operated by trained/experience personnel only.</p> <p>Self-propelled equipment shall have an audible backup alarm.</p> <p>All equipment operations will be performed in accordance with Section 16 of EM 385-1-1.</p>
	Noise Hazards	Utilize hearing protection.
	Hand/Power Tools	<p>Hand/Power tools shall be inspected before each use.</p> <p>Use tools designed for the activity.</p>
	Cold Stress	Follow the heat stress procedures referenced in the SHSP.

TABLE 2
CDM Federal
Activity Hazard Analysis
Soil Drilling

<i>Principal Steps</i>	<i>Potential Hazards</i>	<i>Recommended Controls</i>
1. Drill Rig Staging	Uneven Terrain	Inspection or determination of road conditions and structures shall be made in advance to assure that clearances and load capacities are safe for passage or placing of any machinery or equipment. Whenever the equipment is parked, parking braked on incline will have wheels chocked. Above and below ground utilities will be located prior to staging equipment.
	Inadequate Clearance	Equipment shall maintain minimum clearance of 15' from overhead power lines. Drill rig will not be moved with mast in upright position.
2. Drill Rig Operation	Faulty/Damaged Equipment	Equipment will be inspected at beginning and during each shift. Equipment found to be unsafe will be tagged and locked out by the Site Health and Safety Officer (SHSO).
	Falling Objects	Wear hard hat, remove unsecured tools and materials suspended overhead. Do not pass under materials suspended overhead.
	Pinch/Contact Points	Keep feet and hands clear of moving/suspended materials and equipment. Machine guards shall remain in place. Use long handled shovel to remove auger cuttings. Use safe lockout procedures for maintenance work.
	Fire Hazards	Equipment will be shut down prior to fueling. Use good housekeeping procedures. have adequate fire protection devices available. Inspect monthly. Make eye contact with operator before approaching. Do not exceed load limits or speeds specified by manufactures. Never walk behind moving equipment. Equipment requiring an operator shall not be permitted to run unattended. Use safety belts and lifelines at unprotected elevations above 6 feet. Utilize hearing protection above 85 decibels.
	Heavy Lifting	Use proper lifting techniques. Use mechanized equipment for large heavy objects. Do not overload drums with soil.
3. Soil Sampling Logging	Slips, Trips, Falls	Use good housekeeping procedures. Inspected work area continuously.
	Hand and Power Tools	Inspect tools before each use. Throwing tools or materials is forbidden.
	Heat Stress	Follow heat stress procedures as outlined in SHSP.
	Sharp Hand Tools	Use gloves designated in SHSP. Use tools designed for activity.
	Contact with Potentially Contaminated Soils/Groundwater	Keep contact with soil to a minimum. Use good personal hygiene practices. Use splash protection and chemically resistance gloves to prevent contact with groundwater.

The drilling subcontractor is responsible for the equipment reinspection before the expiration date. Equipment that has not been inspected or that did not pass inspection shall not be allowed to operate at the drilling site. It is the responsibility of the subcontractor to insure all inspections are current. All equipment shall be visually inspected daily prior to any equipment start-up by the drilling sub-contractor.

2.2 EQUIPMENT SAFETY REQUIREMENTS

General: All field equipment including, but not limited to, rigs, water trucks, utility trailers, etc., are to be visually clean prior to mobilizing to a site and prior to demobilization from the site.

2.2.1 DRILL RIGS

Drill rigs must be of a size adequate to accomplish the required project work without placing undue strain on the rig or the mast and without endangering any person at the drill site. The mast and cables must be able to support all equipment and drill rods without failure. Wire cables must be maintained in good condition, free of bad kinks or broken strands. All rotating shafts, pulleys or chains must be covered with protective guards.

Drill rigs must be maintained in safe mechanical working condition. Excessive noise (> 115 dB at > 15 -minute durations) or exhaust fumes coming from a drill rig shall not be allowed. All operating controls, including the cable brake drum, must function properly. All drill rigs must be equipped with at least two emergency kill switches readily accessible to crew personnel at the rear of the drill rig. All personnel, including supervisory and oversight, working on or around the rig are to know the location of the kill switch and how to use it.

2.2.2 WATER TRUCKS

All water trucks must have a gross vehicle weight rating adequate to carry a full load of water without overstressing any component of the drive train or structural framework. All water tanks must be securely fastened to the truck frame so that the movement of the tank in any direction is not possible. Water tanks should be constructed of materials with adequate side strength to prevent structural bloating, baffled to prevent the sloshing of water from side to side, and must have lids with gaskets to prevent water loss during transport. Water trucks should have heavy-duty brakes and tires that are maintained in good condition.

2.2.3 STEAM CLEANERS

Skid mounted steam cleaners shall have protective guarding on all rotating shafts, belts, and pulleys. Steam cleaners which are trailer mounted shall be mounted on trailers with a load rating greater than what is required to support both the cleaner/heating mechanism and a full tank of water. All rotating shafts, belts and pulleys must be covered with protective guards. The tongue of the trailer on which a steam cleaner is mounted must have a swing-down or crank-down support. The trailer must have operating tail and brake lights and safety chains, which must be used when being towed. If a battery, direct current (DC), is used to start the steam cleaner, it shall have protective covers on the terminals. Steam cleaners which are operated with alternating

current (AC) shall be operated with a ground fault interrupter (GFI) circuit. Steam cleaners must always be turned off and allowed to cool before being refueled.

2.2.4 UTILITY TRAILERS

All utility trailers shall be maintained in good condition for hauling loads. The tires on utility trailers should be heavy-duty and rated for the maximum rated trailer load weight. Tires should be free of cuts or other damage. Any load carried on a trailer must be held down securely so that no movement shall occur in any direction. The trailer load limit must not be exceeded. Utility trailers must have working tail and brake lights and safety chains which must be used when being towed.

When parked at a work site, any equipment that has a tendency to roll (drill rods, tremie pipe, etc.) must be held in place on the trailer with either chocks or metal stakes set in side pockets. Equipment must not be left unsecured so that it could roll off the side of the trailer.

2.2.5 PORTABLE GENERATORS/ARC WELDERS

Portable generators or arc welding machines that are mounted on trailers must be grounded while in use. When not in use, generators or welders need not be grounded, but must be chocked and secured from rolling. The trailers on which generators or welding machines are mounted must have a tongue support stand, operating tail and brake lights, and safety chains.

3.0 DRILL CREW PERSONNEL

Drilling operations are to be accomplished with crews large enough (minimum of two personnel) to do the required work in a safe manner. Helpers should be instructed in the operation of the drill rig and safe working practices before being assigned to work. All drill crew personnel must be given a drilling safety orientation when they begin work, and annually thereafter.

Only trained and authorized personnel shall operate and/or assist in drilling operations.

Drill rig operators must comply with applicable state certifications as required.

4.0 SAFE OPERATING PRACTICES

4.1 USE OF SAFETY EQUIPMENT

4.1.1 HARD HATS

All persons must wear an approved hard hat which complies with ANSI Standard Z89.1-1968 when inside the barricade around a drilling work site, unless no work is in progress. Hard hats are to fit snugly to prevent falling off while leaning or bending over.

4.1.2 SAFETY GLASSES

All persons inside the barricade around a drilling work site must wear approved safety glasses with side shields which meet ANSI Standard Z87.1-1979, unless no work is in progress.

Safety glasses are to be worn so as to protect the eyes at all times. They are not to be worn in such a position that they would afford little or no eye protection, such as down on the wearer's nose. Safety glasses are to be kept clean and free of mud and scratches.

4.1.3 STEEL-TOED BOOTS

The use of steel-toed boots that meet ANSI 241.1-1972 is required for drill crew and technical oversight personnel.

4.1.4 SAFETY BELT

A safety belt that meets ANSI Standard A10.14 must be worn by drill crew personnel when climbing the mast of the drill rig and/or working more than four feet above the bed of the drill rig. Once at the location on the mast where work is to be done, the safety line must be looped around a sound structural member of the mast and hooked back onto the safety belt. The safety line must remain attached to the mast as long as the wearer is working above the rig bed level. The safety line must limit any fall to a maximum distance of four feet.

A safety belt must be worn by workers who climb to the top of a cement truck to hold a hose of bentonite into the cement mix. The safety line must be secured to a handrail or other structural support while the worker is leaning over the rotating drum of the truck and injecting the bentonite into the cement. The safety line must limit any fall to a maximum distance of two feet.

4.1.5 HEARING PROTECTION

The use of hearing protection devices that meet ANSI Standard S3.19-1974 is required for all persons inside the barricade during all drilling operations.

4.1.6 RESPIRATORS

Respirators, i.e., dust masks, shall be worn by subcontractor and technical oversight personnel when sacks of bentonite powder and/or cement are being opened and mixed onsite. Other persons in the work area who could breathe bentonite or cement dust also should wear respirators. In addition, drill crew personnel who open and pour sacks of sand into the well shall also wear respirators while this is being done. Respirators shall also be worn when required by the site health and safety plan. Respirators are to be NIOSH/MSHA approved and comply with standards set forth in 29 CFR 1910.134.

4.1.7 GLOVES

The use of gloves for hand and finger protection is generally required for all drilling operations. However, there are some circumstances in which wearing gloves could actually be more hazardous, such as when working around pulleys, belts, chains, and rotating shafts. Drill crew personnel are therefore allowed the discretion of not wearing gloves for certain tasks if they believe that such tasks can be accomplished more safely without gloves. For other routine tasks or operation of equipment, gloves should be worn by all drill crew personnel at all times. Gloves are to be selected based on the types of contaminants anticipated.

The preferred glove for routine drilling operations is the cotton work glove with plastic "non-slip" beads or grips. The use of leather gloves, which may become slippery when wet, is discouraged. Chemical resistant gloves must be worn by drill crew personnel if skin contact with potentially contaminated materials may occur.

4.2 WORK SITE SAFETY REQUIREMENTS

4.2.1 WORK SITE BARRICADES

As soon as a drill rig is driven onto a work site, a barricade must be erected around the drilling end of the rig. This barricade is to consist of rope or barrier tape at a minimum and have a radius of at least 30 feet or 1.5 times the height of the drilling mast. The barricade must extend outward from the rig far enough to contain any equipment that might fall from the rig mast. This includes drill rods, tremie pipes, or well casings that may be leaned or stacked vertically against the mast.

The barricade must extend around the entire work site perimeter at waist height. No person is to go inside this barricade without wearing a hard hat and safety glasses with side shields and hearing protection when work is in progress or the drill rig is running. This personal protective equipment is a minimum requirement.

The barricade must be maintained in position as long as the drill rig is at the site. Should it become necessary to lower the barricade, such as for the water truck to enter or leave, it must be put back up immediately.

4.2.2 DRILL RIG SETUP

Once a barricade has been erected all around the work site, the rig can be leveled and the mast raised to the vertical position. A rig helper or observer should stand along side of the mast as it is being raised, to watch for obstructions or equipment problems. Any potential problems should be brought to the attention of the rig operator immediately.

Once the mast is in full upright position, it must be locked in place. The rig may then be adjusted for final leveling. The rig is not to be driven with the mast in an upright position.

All required equipment and materials should then be placed around the work site in a neat and orderly manner. Particular attention should be given at this time to potential safety hazards from objects which could fall from the bed of the drill rig or roll off of a utility trailer. Drilling operations shall not begin until all equipment is in place and the crew is ready to devote full attention to the required work.

4.2.3 MUD PANS, MUD PITS

Mud pans or mud pits are to be used as appropriate to the well being installed. If a mud pan is used, an effort must be made by the drill crew to dispose of the excess cuttings in such a manner as to avoid having slippery footing around the pan. If it becomes necessary to stand on the mud pan in order to work on the well installation, a steel grate must be placed on top of the pan. The

grate must stay in a fixed position, and not slide about on the pan. It must have adequate strength to support the drill crew.

If a mud pit is to be used at a drill site, it should be dug out, no deeper than 24 inches, with as little disturbance to the surrounding area as possible. It must be completely lined with 4 mil plastic sheeting.

Mud pits must be completely enclosed by a rigid barricade. The barricade should be placed at least three feet back from the edge of the excavation, must be approximately 42 inches high, and strong enough to withstand a 200-pound side force. The barricade may be constructed of 2 x 4 lumber, steel tube and couplings, angle iron, or other rigid materials. The rigid barricade and mud pits should be enclosed within the barricade that surrounds the entire work area. Entry into the mud pit is prohibited once drilling operations have begun.

Upon completion of work at a drill site, all mud pits must be filled in with clean soil and compacted, after plastic has been removed and containerized for disposal as per site or facility IDW guidance.

4.2.4 DRILL ROD, DRILL BIT STABILIZERS

Drill rods and drill bit stabilizers must be transported to a work site either in a rack designed to hold such equipment on the drill rig or water truck, or on a utility trailer. If transported on a utility trailer, the drill rods and/or bit stabilizers must be held securely in place so that they shall not roll from side to side. In addition, metal stakes must be placed on the sides of the trailer to prevent any loose rods from falling off.

At a work site, drill rods and drill bit stabilizers should be set out so that they can be picked up and laid down in a safe manner. They may be laid on cross-ties on the ground, on steel support racks, or left on the utility trailer. Regardless of where they are placed, they must be secure from rolling and/or falling. Any support racks used to hold drill rods or stabilizers must have adequate strength to hold this equipment without collapsing. Drill rods and drill bit stabilizers placed directly on the ground must be chocked to prevent rolling.

Drill rods and drill bit stabilizers are to be lifted onto the rig mast through the use of an approved lifting coupling or thread adapter only. Such tools are to be inspected by the drill rig operator for proper condition each day before the start of work. Any lifting tool that is not in operational condition must be removed from the work site until repairs have been made. Badly worn or damaged lifting tools may not be used.

The drill rig operator must make certain that a lifting tool is properly attached before attempting to lift any equipment. In addition, the operator must lift equipment or tools in such a manner as to not endanger any person standing in the vicinity of the drill rig.

4.2.5 WIRE CABLES

All wire cables on a drill rig are to be inspected by the drill rig operator before the start of work each day. Rig cables must be free of broken strands or weak spots. Any wire cable that has broken strands must be replaced.

Wire cable that is badly kinked, mashed, or otherwise damaged must be taken out of service and replaced prior to any work.

All cable clamps must be installed with the U-bolt placed on the short end of the cable. At least two cable clamps are to be installed on each loop. Drill rig operators should inspect cable clamps daily to ensure that the clamp nuts have not worked loose. The cable should be cut clean, free of any projecting strands, and wrapped with fiberglass impregnated strapping tape or equivalent.

Under no circumstances should a drill rig operator exceed the rated cable load strength. In the event a drill rod string or well casing becomes stuck in the hole, the operator must work the equipment loose without endangering anyone or stop work.

All wire line hoist drums must have a positive locking mechanism which is maintained in good working order.

4.2.6 FIRE EXTINGUISHERS

At least one fully-charged fire extinguisher must be present at each drilling location whenever any work is in progress. The minimum acceptable extinguisher rating is 10-pound ABC. The extinguisher must be mounted in a visible and accessible location on the side of the drill rig, or placed on the ground at least ten feet from the work platform at the rear of the drill rig. It should be quickly and easily accessible in the event of fire. The extinguisher should not be placed in a location where it interferes with work or is likely to be knocked over.

The fire extinguisher must be maintained in a fully-charged condition at all times. Should the fire extinguisher become partially or completely discharged for any reason, it must be recharged or replaced with a fully-charged extinguisher. Extinguishers are to be periodically inspected and maintained in accordance with manufacturer's specifications.

A fire extinguisher must be present and readily accessible whenever any equipment is being refueled at a drilling work site. When welding equipment or a cutting torch is being used at a work site, the extinguisher must be located within 30 feet of any source of flame.

4.2.7 WHEEL CHOCKS

All vehicles and wheeled equipment brought onto a drill site must have chocks placed under the wheels to prevent rolling. Wheel chocks are to be constructed of reinforced rubber.

Water trucks, utility trailers, steam cleaners, portable generators and all similar equipment must have chocks placed under the wheels when parked at a work site. Vehicles which come to a work site for short periods of time, such as cement trucks and fuel trucks, must have chocks placed

under the wheels anytime the driver is not at the controls of the vehicle. Vehicles such as water trucks which leave a work site periodically must take the chocks with them, use them while parked elsewhere, and replace them under the wheels immediately upon return to the work site. Drill rigs, mobile cranes, and other vehicles equipped with hydraulic jacks are not required to be chocked when fully supported by the jacks. When the jacks are not in use, chocks must be in place. Tractors that are equipped with backhoes and/or buckets need not be chocked when parked, provided the backhoe and bucket are lowered to the ground.

4.2.8 FLAMMABLE AND COMBUSTIBLE MATERIALS

Flammable and combustible liquids such as gasoline or diesel fuel may be brought onto a work site by either of two methods: a) in bulk containers, or b) in U.L.-approved safety containers which are clearly posted with "No Smoking or Open Flame" signs.

If a flammable or combustible liquid is brought onto a drilling site in a bulk container, the container must be permanently mounted on the transporting vehicle. Fuel may not be transported in unsecured 55-gallon drums. Bulk containers must be clearly marked as to contents and in accordance to Department of Transportation (DOT) regulations. Bulk fuel delivery trucks must have a grounding wire which is to be used whenever equipment is being refueled.

Flammable and combustible fuels may also be brought onto a drilling location in U.L.-approved 5-gallon metal cans. Such cans must have explosion-resistant (flap-type) lids, and must be clearly marked as to the contents. These cans are not to be stored or left in the back of a pickup truck, but must be kept at a location at least 50 feet away from the drill rig. The area in which fuel cans are stored should be roped off and posted with a "No Smoking or Open Flame" sign. Containers of hydraulic oil, motor oil, and other combustible materials needed at a work site should also be stored at this location.

4.2.9 OXYGEN AND ACETYLENE BOTTLES

Bottles of oxygen and acetylene are to be secured from falling or rolling during transport to the site. When left at the work site, oxygen and acetylene bottles must be stored in an upright position and secured with a chain to a rigid support. These bottles must be secured from falling at all times, including when they are in use.

If the pressure regulators and hoses are not attached to the bottles, then the bottle valve caps must be in place, and screwed down all the way. If the regulators and hoses are attached to the bottles but shall not be used during the course of work that day, they must be removed and the bottle caps installed. Bottle caps shall always be in place on the bottles during transport.

Any time an oxygen/acetylene torch is used to cut metal or for any other purposes, a face shield and leather gloves with wrist and forearm protection must be worn by the person operating the torch. If other persons are required to be in the vicinity of the torch while metal is being cut, they shall wear safety glasses with side shields and leather gloves to protect against burns.

4.2.10 STEAM CLEANERS

The use of steam cleaners is required for equipment and material decontamination. Drill rods, augers, bits, well screens, well casings, and other items must be cleaned of oil and other contaminants before being placed in the borehole.

Due to high pressures and temperatures generated by steam cleaners, safety glasses with side shields must be worn by everyone involved with steaming operations. In the event lens fogging occurs, an anti-fogging ointment or spray shall be used to coat the safety glass lens prior to use of the steam cleaner. If steam cleaning is being done outside the roped-off work area, bystanders must either wear safety glasses or move well away from the cleaning operation. The operator should direct the flow of steam away from other persons.

Hearing protection is required for those persons involved with steaming operations.

Care must always be taken when refueling a steam cleaner. Since most cleaners use an oil burner to produce steam, the burner can easily retain enough heat to ignite fuel. Refueling of a steam cleaner shall only be done after the burner has cooled for more than 15 minutes. Steam cleaners must never be refueled while the engine is running or the burner is in operation.

4.2.11 CATHEADS

A cathead is a rotating steel drum mounted on the drill rig which is used to lift a hammer to drive a soil sampling tool, i.e., a split spoon, into the ground.

The primary requirement for operation of a cathead is that the rig operator be thoroughly experienced and trained in the use of such equipment. Untrained or inexperienced personnel shall not be allowed to operate a cathead.

The rope used on a cathead must be maintained in good condition at all times. Any rope that becomes worn, frayed or scorched must be taken out of service and replaced. In general, if there is any question as to the serviceability or strength of a rope, it should be replaced. Extra care and attention should be given to the rope where it wraps around the cathead, as this is where it is most likely to break. If necessary, the drum should be allowed to cool down before work proceeds.

Rig crews must be careful to avoid working or standing beneath or near the hammer while it is in a position to fall if the rope should break. In order to remove drill rods and/or the drill sampling tool from the hammer, it shall either be held up on the rig mast by a separate securing device that shall support it if the rope breaks or the drill rods and hammer should be laid on the ground for disassembly and assembly. Assembly and/or disassembly of drill tools should never be done while the entire weight of the equipment is held solely by the rope wrapped around the cathead. During the time required to assemble or disassemble the tools, the friction generated by the rotating drum can scorch the rope and cause it to break.

The rig operator shall avoid having anyone or anything become entangled in the cathead rope. The operator shall not wear loose or unbuttoned clothing or gloves with large cuffs which could catch on the rope. The operator shall maintain a minimum of 18 inches clearance between the leading head and the cathead drum. The rope shall not be any longer than is necessary to accomplish the work.

4.2.5 WIRE CABLES

All wire cables on a drill rig are to be inspected by the drill rig operator before the start of work each day. Rig cables must be free of broken strands or weak spots. Any wire cable that has broken strands must be replaced.

Wire cable that is badly kinked, mashed, or otherwise damaged must be taken out of service and replaced prior to any work.

All cable clamps must be installed with the U-bolt placed on the short end of the cable. At least two cable clamps are to be installed on each loop. Drill rig operators should inspect cable clamps daily to ensure that the clamp nuts have not worked loose. The cable should be cut clean, free of any projecting strands, and wrapped with fiberglass impregnated strapping tape or equivalent.

Under no circumstances should a drill rig operator exceed the rated cable load strength. In the event a drill rod string or well casing becomes stuck in the hole, the operator must work the equipment loose without endangering anyone or stop work.

All wire line hoist drums must have a positive locking mechanism which is maintained in good working order.

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The fire extinguisher must be maintained in a fully-charged condition at all times. Should the fire extinguisher become partially or completely discharged for any reason, it must be recharged or replaced with a fully-charged extinguisher. Extinguishers are to be periodically inspected and maintained in accordance with manufacturer's specifications.

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under the wheels anytime the driver is not at the controls of the vehicle. Vehicles such as water trucks which leave a work site periodically must take the chocks with them, use them while parked elsewhere, and replace them under the wheels immediately upon return to the work site. Drill rigs, mobile cranes, and other vehicles equipped with hydraulic jacks are not required to be chocked when fully supported by the jacks. When the jacks are not in use, chocks must be in place. Tractors that are equipped with backhoes and/or buckets need not be chocked when parked, provided the backhoe and bucket are lowered to the ground.

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Flammable and combustible fuels may also be brought onto a drilling location in U.L.-approved 5-gallon metal cans. Such cans must have explosion-resistant (flap-type) lids, and must be clearly marked as to the contents. These cans are not to be stored or left in the back of a pickup truck, but must be kept at a location at least 50 feet away from the drill rig. The area in which fuel cans are stored should be roped off and posted with a "No Smoking or Open Flame" sign. Containers of hydraulic oil, motor oil, and other combustible materials needed at a work site should also be stored at this location.

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If the pressure regulators and hoses are not attached to the bottles, then the bottle valve caps must be in place, and screwed down all the way. If the regulators and hoses are attached to the bottles but shall not be used during the course of work that day, they must be removed and the bottle caps installed. Bottle caps shall always be in place on the bottles during transport.

Any time an oxygen/acetylene torch is used to cut metal or for any other purposes, a face shield and leather gloves with wrist and forearm protection must be worn by the person operating the torch. If other persons are required to be in the vicinity of the torch while metal is being cut, they shall wear safety glasses with side shields and leather gloves to protect against burns.

TABLE 11-3
MINIMUM CLEARANCE FROM ENERGIZED
OVERHEAD ELECTRIC LINES

<u>Nominal system voltage</u>	<u>Minimum required clearance</u>
0-50 kV	10 feet
51-100 kV	12 feet
101-200 kV	15 feet
201-300 kV	20 feet
301-500 kV	25 feet
501-750 kV	35 feet
751-1000 kV	45 feet

c. in transit with boom lowered and no load, the equipment clearance is at least 4 feet for voltages less than 50 kv, 10 feet for voltages of 50 kv or greater up to and including 345 kv, and 16 feet for voltages above 345 kv.

11.E.05 Work activity which could affect or be affected by overhead lines shall not be initiated until coordinated with the appropriate utility officials.

11.E.06 Floating plant and associated equipment shall not be sited or placed within 20 feet of overhead transmission or distribution lines.

11.E.07 Cage boom guards, insulating links, or proximity warning devices may be used on cranes, but such devices shall not alter the requirements of any other regulation of this part - even if such device is required by law or other regulation: insulating links shall be capable of withstanding a 1-minute dry low frequency dielectric test of 50,000 volts, alternating current.

11.E.08 Induced currents.

a. Prior to work near transmitter towers where there is

When setting up a drill rig in a hole location close to an overhead power line, the rig should be parked parallel to the line. Wheel chocks must be placed under the rig at all times when parked in the vicinity of an overhead power line.

When working near power lines, care should be exercised to avoid breaking wire cables, which could then make contact with the line. The drill rig operator should avoid excessive strain on any cable while working in such a location. Any wire cable that is in marginal condition should be replaced before beginning work near a power line. In addition, drill rods are not to be leaned against the mast of the rig while working near an overhead power line.

4.2.14 OTHER UNDERGROUND LINES

Other types of lines, such as communications lines, gas lines, water pipelines, and drain lines are commonly a concern at drilling locations. It is the responsibility of the driller to verify that no buried lines of any type are present at specified drill hole locations. Verification is to be documented through local and/or facility utility clearing services.

If the drill bit encounters anything hard, such as concrete, all drilling must stop at that location. Drill rig operators may not move the rig and try to drill again, however, must remain within the area which was cleared by utility authorities.

4.2.15 SEVERE WEATHER

Most drilling activities routinely continue through hot weather, cold weather, and light rain. During these conditions, rig operators should watch their crews for signs of heat exhaustion in the summer and hypothermia in the winter. The rig operator and/or drilling supervisor should take any steps necessary to bring the crew members back to full working potential so that accidents can be avoided.

It is recommended that work stop when rain interferes with drilling operations to the point of causing a safety hazard. Such hazards can exist when vision is impaired, when workers are more concerned with staying dry than with the work being done, or when footing becomes slippery and difficult.

When icy conditions exist, most drill rigs are coated with ice, and work should not be attempted until the ice has been cleared from the drill rig.

A more common weather problem, particularly during the summer months, is that of lightning encountered with thunderstorms. Due to the construction of a drill rig, the mast can act as a very efficient lightning rod. In the event lightening is identified, drilling activities shall stop, the mast of the rig shall be lowered (if possible), and the crew, including the operator, must move away from the drill rig and take cover in other vehicles or shelter. No one shall remain on or anywhere near the drill rig when lightning is in the area. The crew may return to the rig and resume work only when lightening has moved away from the area. No exceptions to this policy shall be allowed, regardless of problems with well installations that could occur as a result of stopping work.

APPENDIX B

HEAT AND COLD STRESS MANAGEMENT

13.0 TEMPERATURE EXTREMES

13.1 INTRODUCTION

A majority of CDM Federal project activities are performed in outdoor locations and, as such, employees occasionally perform these activities in elevated and depressed temperatures extremes. In light of this, it's important that all employees understand the signs and symptoms of potential injuries associated with working in temperature extremes.

13.2 HEAT STRESS

Heat stress occurs when the body's physiological processes fail to maintain a normal body temperature because of excessive heat. The body reacts to stress related to heat a number of different ways. The reactions range from mild, such as, fatigue, irritability, anxiety, and decreased concentration, to severe, such as death. Heat related disorders are generally classified into four basic categories: heat rash, heat cramps, heat exhaustion, and heat stroke. The descriptions, symptoms, and treatment for these diseases are described as follows.

Heat Rash

Description - Heat rash is caused by continuous exposure to heat and humid air and is generally aggravated by coarse clothing. This condition decreases the ability to tolerate heat. This condition is the mildest of heat related disorders.

Symptoms - Mild red rash which is generally more prominent in areas of the body in contact with personal protective equipment.

Treatment - Decrease the amount of time in personal protective equipment and use powder to help absorb moisture.

Heat Cramps

Description - Heat cramps are caused by perspiration that is not off-set with adequate fluid intake. This condition is the first sign of a situation that can lead to heat stroke.

Symptoms - Acute, painful spasms occurring in the voluntary muscles (e.g., abdomen and extremities).

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Treatment - Remove victim to a cool area and loosen clothing. Have victim drink 1-2 cups of water immediately and every 20 minutes thereafter until the symptoms subside. Total water consumption should be 1-2 gallons per day. Consult with a physician.

Heat Exhaustion

Description - Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is more severe than heat cramps.

Symptoms - Pale, clammy, moist skin with profuse perspiration and extreme weakness. Body temperature is generally normal and the pulse is weak and rapid. Breathing is shallow. The victim may show signs of dizziness and may vomit.

Treatment - Remove the victim to a cool, air conditioned atmosphere. Loosen clothing and require that the victim lay in a flat position with the feet slightly elevated. Have the victim drink 1-2 cups of water immediately and every 20 minutes until the symptoms subside. Seek medical attention, particularly in severe situations.

Heat Stroke

Description - Heat stroke is an acute and dangerous situation. It can happen in a very short time period. The victims temperature control system shuts down completely resulting in a rise in body core temperature to levels that can cause brain damage and can be fatal if not treated promptly and effectively.

Symptoms - Red, hot, dry skin, with no perspiring. Rapid respiration, high pulse rate, and extremely high body temperature are other symptoms.

Treatment - Cool the victim quickly. If the body temperature is not brought down fast, permanent brain damage or death can result. The victim should be soaked in cool water. Get medical attention as soon as possible.

13.2.1 PREVENTIVE MEASURES

There are a number of steps that can be taken to minimize and/or eliminate the potential for heat stress disorders when working in hot atmospheres. Some of these are as follows:

- Acclimate employees to working conditions by slowly increasing workloads over extended periods of time. Do not begin site work activities with the most demanding physical expenditures.

- Where possible, conduct strenuous activities during cooler portions of the day, such as, early morning or early evening.
- Provide and encourage all employees to drink lots of tempered water during the course of the work shift and discourage the use of alcohol during nonworking hours. It's essential that fluids lost due to perspiration get replenished.
- During hot periods, use administrative controls to limit exposure.
- Provide cooling devises when appropriate. Mobile showers and/or hose down facilities, powered air purifying respirators, and ice vests have all proven effective in reducing heat stress potential.

13.2.2 HEAT STRESS MONITORING

For strenuous field activities that are part of on-going site work activities in hot weather, the following procedures are used to monitor the body's physiological response to heat. These procedures are implemented when employees are required to wear impervious clothing in atmospheres exceeding 70°F.

- **Monitor Heart Rate (HR)** - Heart rate should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The measurement at the beginning of the rest period should not exceed 110 beats/minute. If the heart rate is in excess, the next work period should be shortened by 33 percent, with the length of the rest period remaining the same. If the heart rate is still in excess at the beginning of the next rest period, the following work cycle should be shortened by 33 percent. This procedure continues until the rate is maintained below 110 beats/minute.
- **Monitor Body Temperature** - Body temperature is measured orally or by ear with a clinical thermometer as early as possible in the resting period. Temperatures should not exceed 99.6°F. If it does, the next work period should be shortened by 33 percent. If the oral temperature at the end of the next work period still exceeds 99.6°F, the following work cycle is shortened by another 33 percent. This procedure continues until the body temperature is maintained below 99.6°F.

The Wet-Bulb Globe Temperature (WBGT) Index is a method of monitoring environmental factors that most nearly correlate to an individual's physiological response to heat. This method uses a black globe thermometer, a natural wet-bulb thermometer, and a dry-bulb thermometer. From measurements with these instruments, the WBGT can be calculated. The WBGT is then compared with work load categories with the result being the establishment of recommended work/rest regimens. Examples of permissible heat exposure threshold limit values are as follows.

Examples of Permissible Heat Exposure Threshold Limit Values (Values are given in °C and (°F) WBGT°)			
Work-Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% work - 25% rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% work - 50% rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% work - 75% rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

As workload increases, the heat stress impact on an unacclimatized worker is exacerbated. For unacclimatized workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

13.3 **COLD STRESS**

Persons working outdoors in low temperatures, especially at or below freezing, are subject to cold stress disorders. Exposure to extreme cold for even a short period of time can cause severe injury to the body surfaces and/or profound cooling which can lead to death. Areas of the body that have high surface area-to-volume ratios, such as, fingers, toes, and ears, are the most susceptible.

There are basically two types cold disorders. They can be classified as localized, as is the case with frostbite, or generalized, as in hypothermia. The descriptions, symptoms, and treatment for these diseases are described as follows.

Hypothermia

Description - As the temperature of the body drops, the thermo-regulatory system attempts to increase the body's generation of heat. This regulation includes the constriction of surface blood vessels, to conserve energy, and the body's production of glucose, to increase the body's metabolic rate, i.e., to be used as fuel to generate heat.

Symptoms - Uncontrollable shivering with the sensation of cold. Slower heartbeat and a weaker pulse are also symptoms.

Treatment - Get individual to a warm environment.

Frostbite

Description - Frostbite is a condition in which the fluids around the cells of body tissues freezes. The condition results in damage to and loss of tissue. The most vulnerable parts of the body are the nose, cheeks, ears, fingers, and toes.

Symptoms - Affected areas become white and firm.

Treatment - Get the individual to a warm environment and rewarm the areas quickly. Keep affected areas covered and warm. Warm water can be used to thaw the areas.

13.3.1 PREVENTIVE MEASURES

There are a number of steps that can be taken to minimize/eliminate the potential for cold stress disorders when working in a cold environment. Some of these are as follows:

- As with warm environments, individuals can achieve a certain degree of acclimation when working in cold environments. The body will undergo some changes that will increase the body's comfort and also reduce the risk to cold injury.
- Working in cold environments causes significant water losses through the skin and the lungs as a result of the dryness of the air. Increased fluid intake is essential to prevent dehydration, which effects the flow of blood to the extremities and increases the risk of cold injury. Warm, sweet, caffeine-free, nonalcoholic drinks and soups should be readily available.
- Do not allow skin to be continuously exposed to sub-zero temperatures.

13.3.2 COLD STRESS MONITORING

Air temperature alone is not sufficient to judge the potential for cold-related disorders in a particular environment. Heat loss from convection, air movement at the surface of the skin, is probably the greatest and most deceptive factor in the loss of body heat. For this reason, wind speeds as well as air temperatures need to be considered when evaluating a potential for cold stress disorders. The resultant windchill index and the potential danger to exposed individuals have been tabulated as shown in Table 13-1.

**TABLE 13-1
WINDCHILL INDEX**

Wind Speed in mph	Actual Thermometer Reading (F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	Equivalent Temperature									
Calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	Little Danger (for properly clothed person)				Increasing Danger (Danger from freezing of exposed parts)			Great Danger (Danger from freezing of exposed parts)		

The human body senses "cold" as a result of both air temperature and wind velocity. Cooling of exposed flesh increases rapidly as the wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrated the body insulation. For example, when the actual air temperature of the wind is 4.4 C (40 F) and its velocity is 48 km/h (30 mph), the exposed skin would perceive this situation as a equivalent still air temperature of -11 C (13 F).

APPENDIX C
RADIATION SCREENING PROGRAM

RADIOLOGICAL CONTROL

Historical data have indicated the presence of radioactive materials in properties adjacent to the AWI site. Although there is no direct evidence of radioactive contamination at the site, radiological control considerations are being included in the SSHP to ensure that the presence of radioactivity above background levels would be identified and properly controlled. If significant levels of radioactivity are identified during the investigation, the SSHP will be amended to include the necessary precautions to ensure worker safety and protect the general public.

1. Introduction

The presence of radioactive materials at adjacent properties was generally limited to low levels of radium-226 (^{226}Ra) associated with radium dials and self-luminous materials commonly used in ships and aircraft. In 1981, an aerial radiation monitoring survey was performed and radiation levels were confirmed with surface radiation measurements and soil sampling. The results indicated that radiation levels were not significantly different than background. The survey concluded that there are no locations where radioactivity is present.

The potential for radiological hazards at the AWI site is unlikely. There is no concern that workers may receive a significant (measurable) external radiation dose. However, there is a possibility that subsurface contamination from previous filling activities in the Navy leased area may be uncovered during sampling and drilling activities. The radiological controls in the SSHP will focus on identifying radioactive contamination as close to the source as possible and preventing the spread of contamination to any uncontrolled area.

2. Contamination Control Methods

a. Access Control

A single designated access control point will be established for all field work at the site. All equipment and personnel must use the same access point for entry and exit. The SHSO will perform a “frisk” survey of personnel and equipment to ensure that no contamination is spread beyond the site boundary. Alpha and beta/gamma portable survey instruments will be used for scanning. Personnel, equipment, or tools, with readings greater than 20% above background indicate suspected contamination and should be decontaminated before reuse or transport from the site. Significant levels of contamination (greater than two-times background) will be immediately investigated to identify the specific radionuclide and area of the site where the contamination originated.

b. Job Coverage

Soil cuttings and residues will be scanned with alpha and beta/gamma portable survey instruments during field activities. There is a potential for subsurface contamination to be brought to the surface during soil/sediment sampling and well drilling. Equipment will

be decontaminated to levels within 20% of background before use at another sampling location.

Workers involved in handling sampling and drilling equipment should have their hands (gloves) and boots “frisked” by the SHSO before moving to another sampling/drilling location. Tires, floorboards, etc. of vehicles and drilling rigs should be routinely scanned by the SHSO during the project.

c. Sample Screening

Samples will be screened for radioactivity before shipment to offsite labs for analyses. The exterior of the container will be scanned for activity to ensure that levels are less than two-times background. Samples that indicate greater than twice background will be suspected to contain radioactive contamination. These samples may be identified for further radiological analyses, etc.

3. Instrumentation and Survey Methods

Two types of portable radiation survey instruments will be used during the investigation. An alpha scintillation probe will be used with a scaler/ratemeter to detect the presence of alpha contamination. A pancake G-M probe will be used with a scaler/ratemeter to detect the presence of beta/gamma emitting radionuclides. Scaler/ratemeters are useful for scanning with the audible output or for fixed counting at preset count times. Although the instruments are useful for identifying relatively low levels of radioactivity, they do not identify the specific radionuclides present.

a. Daily Instrument Checks

All instruments will be checked for proper operation and valid calibration prior to each use. Radioactive check sources are included with each instrument. Response checks should be within $\pm 20\%$ of the reference source check and background check. Instruments should be taken out of service if readings are outside the $\pm 20\%$ control limits. Daily background and source checks (one minute timed counts) should be recorded and maintained with field log records. It is normal to observe statistical fluctuations in background and source checks.

Since the instruments will not be used for directly quantifying contamination levels, some minor maintenance may be acceptable. For example, scaler/ratemeter batteries may be replaced or a torn Mylar window may be replaced on the alpha scintillation probe. Backgrounds and response checks need to be re-established and verified after any maintenance. Equipment should be returned to the supplier for replacement if operational problems are evident.

b. Surface Scanning

Scan the surface at a rate that does not exceed 1½ in./sec. Hold the probe within approximately ¼ in. of the surface and use the audible output of the instrument. As the count rate increases, pause to determine if the increased count rate is greater than background. Perform a one-minute timed count at locations where the count rate is greater than background. Take necessary actions when counts are greater than 20% over background or two-times background. Perform primary scanning with beta/gamma instruments and repeat scanning with alpha survey instruments.

c. One-Minute Timed Counts

One-minute timed counts are used as a direct measurement to confirm an area of contamination. Personnel and equipment with discrete areas where the measurements are greater than 20% over background indicate the need for decontamination. Whereas, counts that are greater than two times background may indicate significant contamination that requires further investigation. To perform a one-minute count the probe is placed on the surface and the scaler/ratemeter is adjusted and set to start the one-minute count. The accumulated counts are compared with the background established for that instrument. Multiple counts may be necessary to help verify whether counts are significantly different from background.

APPENDIX D

USACE ACCIDENT INVESTIGATION REPORT FORM (ENG 3394)

(For Safety Staff only)		REPORT NO	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT <small>(For Use of this Form See Attached Instructions and USACE Suppl to AR 385-40)</small>			REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)						
ACCIDENT CLASSIFICATION													
PERSONNEL CLASSIFICATION			INJURY/ILLNESS/FATAL		PROPERTY DAMAGE		MOTOR VEHICLE INVOLVED		DIVING				
GOVERNMENT <input type="checkbox"/> CIVILIAN <input type="checkbox"/> MILITARY			<input type="checkbox"/>		<input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		<input type="checkbox"/>		<input type="checkbox"/>				
<input type="checkbox"/> CONTRACTOR			<input type="checkbox"/>		<input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		<input type="checkbox"/>		<input type="checkbox"/>				
<input type="checkbox"/> PUBLIC			<input type="checkbox"/> FATAL <input type="checkbox"/> OTHER		XXXXXXXXXX		<input type="checkbox"/>		XXXXXXXXXX				
PERSONAL DATA													
a NAME (Last, First MI)			d AGE	c SEX <input type="checkbox"/> MALE <input type="checkbox"/> FEMALE		e SOCIAL SECURITY NUMBER			f GRADE				
g JOB SERIES/TITLE			h DUTY STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ON DUTY <input type="checkbox"/> TDY <input type="checkbox"/> OFF DUTY			i EMPLOYMENT STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ARMY ACTIVE <input type="checkbox"/> ARMY RESERVE <input type="checkbox"/> VOLUNTEER <input type="checkbox"/> PERMANENT <input type="checkbox"/> FOREIGN NATIONAL <input type="checkbox"/> SEASONAL <input type="checkbox"/> TEMPORARY <input type="checkbox"/> STUDENT <input type="checkbox"/> OTHER (Specify) _____							
GENERAL INFORMATION													
a DATE OF ACCIDENT <small>(month/day/year)</small>		b TIME OF ACCIDENT <small>(Military time)</small>		c EXACT LOCATION OF ACCIDENT			d CONTRACTOR'S NAME (1) PRIME						
e CONTRACT NUMBER <input type="checkbox"/> CIVIL WORKS <input type="checkbox"/> MILITARY <input type="checkbox"/> OTHER (Specify) _____		f TYPE OF CONTRACT <input type="checkbox"/> CONSTRUCTION <input type="checkbox"/> SERVICE <input type="checkbox"/> A/E <input type="checkbox"/> DREDGE <input type="checkbox"/> OTHER (Specify) _____		g HAZARDOUS/TOXIC WASTE ACTIVITY <input type="checkbox"/> SUPERFUND <input type="checkbox"/> DERP <input type="checkbox"/> IRP <input type="checkbox"/> OTHER (Specify) _____			(2) SUBCONTRACTOR						
CONSTRUCTION ACTIVITIES ONLY (Fill in line and corresponding code number in box from list - see instructions)													
a CONSTRUCTION ACTIVITY (CODE) 				b TYPE OF CONSTRUCTION EQUIPMENT (CODE) 									
INJURY / ILLNESS INFORMATION (include name on line and corresponding code number in box for items e, f, g - see instructions)													
a SEVERITY OF ILLNESS / INJURY (CODE) 				b. ESTIMATED DAYS LOST		c. ESTIMATED DAYS HOSPITALIZED		d. ESTIMATED DAYS RESTRICTED DUTY					
e. BODY PART AFFECTED PRIMARY SECONDARY 				f TYPE AND SOURCE OF INJURY/ILLNESS TYPE SOURCE 									
g. NATURE OF ILLNESS / INJURY (CODE) 													
PUBLIC FATALITY (Fill in line and corresponding code number in box - see instructions)													
a ACTIVITY AT TIME OF ACCIDENT (CODE) 				b PERSONAL FLOATATION DEVICE USED? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A									
MOTOR VEHICLE ACCIDENT													
a TYPE OF VEHICLE <input type="checkbox"/> PICKUP/VAN <input type="checkbox"/> AUTOMOBILE <input type="checkbox"/> TRUCK <input type="checkbox"/> OTHER (Specify) _____			b TYPE OF COLLISION <input type="checkbox"/> SIDE SWIPE <input type="checkbox"/> HEAD ON <input type="checkbox"/> REAR END <input type="checkbox"/> BROADSIDE <input type="checkbox"/> ROLL OVER <input type="checkbox"/> BACKING <input type="checkbox"/> OTHER (Specify) _____			c. SEAT BELTS		d. USED		e. NOT USED		f. NOT AVAILABLE	
						(1) FRONT SEAT							
						(2) REAR SEAT							
PROPERTY/MATERIAL INVOLVED													
a. NAME OF ITEM				b. OWNERSHIP				c. \$ AMOUNT OF DAMAGE					
VESSEL / FLOATING PLANT ACCIDENT (Fill in line and corresponding code number in box from list - see instructions)													
a TYPE OF VESSEL/FLOATING PLANT (CODE) 				b TYPE OF COLLISION/MISHAP (CODE) 									
ACCIDENT DESCRIPTION (Use additional paper if necessary)													

CAUSAL FACTOR(S) (Read instruction before completing)

a (Explain YES answers in item 13)

YES NO

DESIGN: Was design of facility/workplace or equipment a factor?

☐ YES ☐ NO

INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?

☐ YES ☐ NO

PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?

☐ YES ☐ NO

OPERATING PROCEDURES: Were operating procedures a factor?

☐ YES ☐ NO

JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?

☐ YES ☐ NO

HUMAN FACTORS: Did any human factors such as size or strength of person, etc., contribute to accident?

☐ YES ☐ NO

ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?

☐ YES ☐ NO

b (CONTINUED)

YES NO

CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents such as dust, fumes, mists, vapors or physical agents such as noise, radiation, etc., contribute to accident?

☐ YES ☐ NO

OFFICE FACTORS: Did office setting such as lifting office furniture, carrying, slouching, etc., contribute to the accident?

☐ YES ☐ NO

SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?

☐ YES ☐ NO

PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?

☐ YES ☐ NO

DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?

☐ YES ☐ NO

d WAS A WRITTEN JOB ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES (If yes, attach a copy)☐ NO

12 TRAINING

a WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?

☐ YES ☐ NO

b TYPE OF TRAINING

☐ CLASSROOM ☐ ON JOB

c DATE OF MOST RECENT FORMAL TRAINING

(Month) (Day) (Year)

13 FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES (See instruction for definition of direct and indirect causes. If Use additional paper, if necessary.)

a DIRECT CAUSE

b INDIRECT CAUSE(S)

14 ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S)

DESCRIBE FULLY

15 DATES FOR ACTIONS IDENTIFIED IN BLOCK 14

a BEGINNING (Month/Day/Year)

b ANTICIPATED COMPLETION (Month/Day/Year)

c SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT

d DATE (Mo/Da/Yr)

e ORGANIZATION IDENTIFIER (Div, Br, Sect)

f OFFICE SYMBOL

CORPS

CONTRACTOR

16 MANAGEMENT REVIEW (1st)

a ☐ CONCUR b ☐ NON CONCUR c COMMENTS

SIGNATURE

TITLE

DATE

17 MANAGEMENT REVIEW (2nd - Chief Operations, Construction, Engineering, etc.)

a ☐ CONCUR b ☐ NON CONCUR c COMMENTS

SIGNATURE

TITLE

DATE

18 SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a ☐ CONCUR b ☐ NON CONCUR c ADDITIONAL ACTIONS COMMENTS

SIGNATURE

TITLE

DATE

19 COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE

DATE

GENERAL. Complete a separate report for each person who was injured, caused, or contributed to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the discretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in boxes. If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16 and 17.

INSTRUCTIONS FOR SECTION 1— ACCIDENT CLASSIFICATION. (Mark All Boxes That Are Applicable.)

- a. **GOVERNMENT.** Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.
- (1) **INJURY/ILLNESS/FATALITY**—Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.
 - (2) **PROPERTY DAMAGE**—Mark the appropriate box if accident resulted in any damage of \$1000 or more to government property (including motor vehicles).
 - (3) **VEHICLE INVOLVED**—Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.
 - (4) **DIVING ACTIVITY**—Mark if the accident involved an in-house USACE diving activity.
- b. **CONTRACTOR.**
- (1) **INJURY/ILLNESS/FATALITY**—Mark if accident resulted in any contractor lost-time injury/illness or fatality.
 - (2) **PROPERTY DAMAGE**—Mark the appropriate box if accident resulted in any damage of \$1000 or more to contractor property (including motor vehicles).
 - (3) **VEHICLE INVOLVED**—Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.
 - (4) **DIVING ACTIVITY**—Mark if the accident involved a USACE Contractor diving activity.
- c. **PUBLIC.**
- (1) **INJURY/ILLNESS/FATALITY**—Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).
 - (2) **VOID SPACE**—Make no entry.
 - (3) **VEHICLE INVOLVED**—Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" is marked.
 - (4) **VOID SPACE**—Make no entry.

INSTRUCTIONS FOR SECTION 2— PERSONAL DATA

- a. **NAME**—(MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.
- b. **AGE**—Enter age.
- c. **SEX**—Mark appropriate box.
- d. **SOCIAL SECURITY NUMBER**—(FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).
- e. **GRADE**—(FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6, E-7, WG-8, WS-12, GS-11, etc.

f. **JOB SERIES TITLE**—For government civilian employees enter the pay plan, full series number, and job title, e.g., GS-0810 Civil Engineer. For military personnel enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For contractor employees enter the job title assigned to the injured person, e.g., carpenter, laborer, surveyor, etc.

- g. **DUTY STATUS**—Mark the appropriate box.
- (1) **ON DUTY**—Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.
 - (2) **TDY**—Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.
 - (3) **OFF DUTY**—Person was not on official business at time of accident.
- h. **EMPLOYMENT STATUS**—(FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3— GENERAL INFORMATION

- a. **DATE OF ACCIDENT**—Enter the month, day, and year of accident.
- b. **TIME OF ACCIDENT**—Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).
- c. **EXACT LOCATION OF ACCIDENT**—Enter facts needed to locate the accident scene, (installation/project name, building number, street, direction and distance from closest landmark, etc.).
- d. **CONTRACTOR NAME**
- (1) **PRIME**—Enter the exact name (title of firm) of the prime contractor.
 - (2) **SUBCONTRACTOR**—Enter the name of any subcontractor involved in the accident.
- e. **CONTRACT NUMBER**—Mark the appropriate box to identify if contract is civil works, military, or other; if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.
- f. **TYPE OF CONTRACT**—Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.
- g. **HAZARDOUS/TOXIC WASTE ACTIVITY (HTW)**—Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4— CONSTRUCTION ACTIVITIES

- a. **CONSTRUCTION ACTIVITY**—Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

- | | |
|-------------------------|----------------------------|
| 1. MOBILIZATION | 14. ELECTRICAL |
| 2. SITE PREPARATION | 15. SCAFFOLDING/ACCESS |
| 3. EXCAVATION/TRENCHING | 16. MECHANICAL |
| 4. GRADING (EARTHWORK) | 17. PAINTING |
| 5. PIPING/UTILITIES | 18. EQUIPMENT/MAINTENANCE |
| 6. FOUNDATION | 19. TUNNELING |
| 7. FORMING | 20. WAREHOUSING/STORAGE |
| 8. CONCRETE PLACEMENT | 21. PAVING |
| 9. STEEL ERECTION | 22. FENCING |
| 10. ROOFING | 23. SIGNING |
| 11. FRAMING | 24. LANDSCAPING/IRRIGATION |
| 12. MASONRY | 25. INSULATION |
| 13. CARPENTRY | 26. DEMOLITION |

2. TYPE OF CONSTRUCTION EQUIPMENT — Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24 "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1 GRADER	13 DUMP TRUCK (OFF HIGHWAY)
2 DRAGLINE	14 TRUCK (OTHER)
3 CRANE (ON VESSEL/BARGE)	15 FORKLIFT
4 CRANE (TRACKED)	16 BACKHOE
5 CRANE (RUBBER TIRE)	17 FRONT-END LOADER
6 CRANE (VEHICLE MOUNTED)	18 PILE DRIVER
7 CRANE (TOWER)	19 TRACTOR (UTILITY)
8 SHOVEL	20 MANLIFT
9 SCRAPER	21 DOZER
10 PUMP TRUCK (CONCRETE)	22 DRILL RIG
11 TRUCK (CONCRETE TRANSIT MIXER)	23 COMPACTOR/VIBRATORY ROLLER
12 DUMP TRUCK (HIGHWAY)	24 OTHER

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

- a. SEVERITY OF INJURY / ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below

NOI	NO INJURY
FAT	FATALITY
PTL	PERMANENT TOTAL DISABILITY
PPR	PERMANENT PARTIAL DISABILITY
LWD	LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW	RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA	RECORDABLE FIRST AID CASE
NRI	NON-RECORDABLE INJURY

- b. ESTIMATED DAYS LOST — Enter the estimated number of workdays the person will lose from work.
- c. ESTIMATED DAYS HOSPITALIZED — Enter the estimated number of workdays the person will be hospitalized.
- d. ESTIMATED DAYS RESTRICTED DUTY — Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.
- e. BODY PART AFFECTED — Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH

	CN	NOSE
	CR	THROAT OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EE	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS
		ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP
		ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE, DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL, OTHER

- f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury / illness from the list below. This nature of injury / illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury / illness name on the line and place the corresponding CODE letters in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN
	TC	CONTUSION, BRUISE
	TD	ABRASION
	TE	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES CONDITIONS INCLUDING DERMATITIS
	TF	TRAUMATIC RESPIRATORY DISEASE
	TO	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER, STRESS, NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE, ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	RS	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE; PARASITIC — OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION, STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS, NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
SKIN DISEASE OR CONDITION	SE	BIOLOGICAL
	SC	CHEMICAL
	SE	DERMATITIS, UNCLASSIFIED

§ TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) : Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface)

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) A Park Ranger contracted dermatitis from contact with poison ivy oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal silver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle.
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling in" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN
CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY

CODE	SOURCE OF INJURY NAME
020C	ENVIRONMENTAL CONDITION
021C	TEMPERATURE EXTREME (INDOOR)
022C	WEATHER (ICE, RAIN, HEAT, ETC.)
023C	FIRE, FLAME, SMOKE (NOT TOBACCO)
024C	NOISE
025C	RADIATION
026C	LIGHT
027C	VENTILATION
0271	TOBACCO SMOKE
028C	STRESS (EMOTIONAL)
029C	CONFINED SPACE
030C	MACHINE OR TOOL
031C	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
032C	HAND TOOL (NONPOWERED)
033C	MECHANICAL POWER TRANSMISSION APPARATUS
034C	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
035C	VIDEO DISPLAY TERMINAL
036C	PUMP, COMPRESSOR, AIR PRESSURE TOOL
037C	HEATING EQUIPMENT
038C	WELDING EQUIPMENT
040C	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
043C	COMMON CARRIER (AIRLINE, BUS, ETC.)
044C	AIRCRAFT (NOT COMMERCIAL)
045C	BOAT, SHIP, BARGE
050C	MATERIAL HANDLING EQUIPMENT
051C	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
052C	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
053C	ELEVATOR, ESCALATOR, PERSONNEL HOIST
054C	HOIST, SLING CHAIN, JACK
055C	CRANE
0551	FORKLIFT
056C	HANDTRUCK, DOLLY
060C	DUST, VAPOR, ETC.
061C	DUST (SILICA, COAL, ETC.)
062C	FIBERS
0621	ASBESTOS
063C	GASES
0631	CARBON MONOXIDE
064C	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
065C	PARTICLES (UNIDENTIFIED)
070C	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
073C	PLASTIC
074C	WATER
075C	MEDICINE
080C	INANIMATE OBJECT
081C	BOX, BARREL, ETC.
082C	PAPER
083C	METAL ITEM, MINERAL
0831	NEEDLE
084C	GLASS
085C	SCRAP, TRASH
086C	WOOD
087C	FOOD
088C	CLOTHING, APPAREL, SHOES
090C	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
092C	PLANT
093C	INSECT
094C	HUMAN (VIOLENCE)
095C	HUMAN (COMMUNICABLE DISEASE)
096C	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
100C	PERSONAL PROTECTIVE EQUIPMENT
101C	PROTECTIVE CLOTHING: SHOES, GLASSES, GOGGLES,
102C	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
103C	SAFETY BELT, HARNESS
104C	PARACHUTE

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

- a. **ACTIVITY AT TIME OF ACCIDENT** — Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the most appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident:

WATER RELATED RECREATION

- | | |
|------------------------------------|--|
| 1. Sailing | 9. Swimming/designated area |
| 2. Boating—powered | 10. Swimming/other area |
| 3. Boating—unpowered | 11. Underwater activities (skin diving, scuba, etc.) |
| 4. Water skiing | 12. Wading |
| 5. Fishing from boat | 13. Attempted rescue |
| 6. Fishing from bank, dock or pier | 14. Hunting from boat |
| 7. Fishing while wading | 15. Other |
| 8. Swimming/supervised area | |

NON-WATER RELATED RECREATION

- | | |
|--|--|
| 16. Hiking and walking | 23. Sports/summer (baseball, football, etc.) |
| 17. Climbing (general) | 24. Sports/winter (skiing, sledding, snowmobiling, etc.) |
| 18. Camping/picnicking authorized area | 25. Cycling (bicycle, motorcycle, scooter) |
| 19. Camping/picnicking unauthorized area | 26. Gliding |
| 20. Guided tours | 27. Parachuting |
| 21. Hunting | 28. Other non-water related |
| 22. Playground equipment | |

OTHER ACTIVITIES

- | | |
|--|----------------------------------|
| 29. Unlawful acts (fights, riots, vandalism, etc.) | 33. Sleeping |
| 30. Food preparation/serving | 34. Pedestrian struck by vehicle |
| 31. Food consumption | 35. Pedestrian other acts |
| 32. Housekeeping | 36. Suicide |
| | 37. "Other" activities |

- b. **PERSONAL FLOTATION DEVICE USED** — If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7 — MOTOR VEHICLE ACCIDENT

- a. **TYPE OF VEHICLE** — Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

- b. **TYPE OF COLLISION** — Mark appropriate box.

- c. **SEAT BELT** — Mark appropriate box.

INSTRUCTIONS FOR SECTION 8 — PROPERTY/MATERIAL INVOLVED

- a. **NAME OF ITEM** — Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.
- b. **OWNERSHIP** — Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE*)
- c. **\$ AMOUNT OF DAMAGE** — Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9—VESSEL/ FLOATING PLANT ACCIDENT

- a. **TYPE OF VESSEL/FLOATING PLANT**—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below enter item number for "OTHER" and write in specific type of vessel/floating plant:

VESSEL/FLOATING PLANTS

- | | |
|------------------------|----------------------------|
| 1. ROW BOAT | 7. DREDGE/DIPPER |
| 2. SAIL BOAT | 8. DREDGE/CLAMSHELL BUCKET |
| 3. MOTOR BOAT | 9. DREDGE/PIPE LINE |
| 4. BARGE | 10. DREDGE/DUST PAN |
| 5. DREDGE/HOPPER | 11. TUG BOAT |
| 6. DREDGE/SIDE CASTING | 12. OTHER |

- c. **COLLISION/MISHAP**—Select from the list below the object(s) that contributed to the accident or were damaged in the accident:

COLLISION/MISHAP

- | | |
|-----------------------------|-----------------------|
| 1. COLLISION W/OTHER VESSEL | 7. HAULAGE UNIT |
| 2. UPPER GUIDE WALL | 8. BREAKING TOW |
| 3. UPPER LOCK GATES | 9. TOW BREAKING UP |
| 4. LOCK WALL | 10. SWEEP DOWN ON DAM |
| 5. LOWER LOCK GATES | 11. BUOY/DOLPHIN/CELL |
| 6. LOWER GUIDE WALL | 12. WHARF OR DOCK |
| | 13. OTHER |

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their roles in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

- a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

- DESIGN**—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?
- INSPECTION/MAINTENANCE**—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?
- PERSON'S PHYSICAL CONDITION**—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?
- OPERATING PROCEDURES**—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?
- JOB PRACTICES**—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

- HUMAN FACTORS**—Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person, i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

- ENVIRONMENTAL FACTORS**—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

- CHEMICAL AND PHYSICAL AGENT FACTORS**—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

- OFFICE FACTORS**—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

- SUPPORT FACTORS**—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

- PERSONAL PROTECTIVE EQUIPMENT**—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

- DRUGS/ALCOHOL**—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

- b. **WRITTEN JOB/ACTIVITY HAZARD ANALYSIS**—Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12—TRAINING

- a. **WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?**—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

- b. **TYPE OF TRAINING**—Mark the appropriate box that best indicates the type of training: (classroom or on-the-job) that the injured person received before the accident happened.

- c. **DATE OF MOST RECENT TRAINING**—Enter the month, day, and year of the last formal training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13 — CAUSES

- a. **DIRECT CAUSES** — The direct cause is that single factor which most directly lead to the accident. See examples below.
- b. **INDIRECT CAUSES** — Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13

- a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.
- b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14 — ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION — Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15 — DATES FOR ACTION

- a. **BEGIN DATE** — Enter the date when the corrective action(s) identified in Section 14 will begin.
- b. **COMPLETE DATE** — Enter the date when the corrective action(s) identified in Section 14 will be completed.
- c. **TITLE AND SIGNATURE** — Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15 d, 15 e and 15 f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.
- d. **DATE SIGNED** — Enter the month, day, and year that the report was signed by the responsible supervisor.
- e. **ORGANIZATION NAME** — For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15 c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

- f. **OFFICE SYMBOL** — Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15 e.

INSTRUCTIONS FOR SECTION 16 — MANAGEMENT REVIEW (1st)

1ST REVIEW — Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17 — MANAGEMENT REVIEW (2nd)

2ND REVIEW — The FOA Staff Chief (i.e., FOA Chief of Construction Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18 — SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW — The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc., are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19 — COMMAND APPROVAL

4TH REVIEW — The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

APPENDIX E
MATERIAL SAFETY DATA SHEETS

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 2 - Moderate

Contact Rating: 3 - Severe (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD;
PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:

Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.

Ingestion:

Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea. Swallowing may be fatal.

Skin Contact:

Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.

Eye Contact:

Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Chronic Exposure:

Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes

while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Extreme heat or contact with metals can release flammable hydrogen gas.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

If involved in a fire, use water spray. Neutralize with soda ash or slaked lime.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(tm) or TEAM(tm) 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material

PRODUCT NAME: ISOBUTYLENE

HAZARDOUS DECOMPOSITION PRODUCTS:

Carbon monoxide

11. Toxicological Information

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

No chronic effects data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Isobutylene	Isobutylene
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 1055	UN 1055
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

15. Regulatory Information

Isobutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

SARA TITLE III NOTIFICATIONS AND INFORMATION

SARA TITLE III - HAZARD CLASSES:

Acute Health Hazard

Fire Hazard

Sudden Release of Pressure Hazard

16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

PRODUCT NAME: ISOBUTYLENE

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

Liqui-Nox ®

MATERIAL SAFETY DATA SHEET

Alconox, Inc.
9 East 40th Street, Suite 200
New York, NY 10016

24 Hour Emergency Number - Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	LIQUI-NOX
CAS Registry Number:	Not Applicable
Effective Date:	July 9, 1999
Chemical Family:	Anionic Liquid Detergent

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in LIQUI-NOX™ as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	214°F
Vapor Pressure (mm Hg):	No Data
Vapor Density (AIR=1):	No Data
Specific Gravity (Water=1):	1.075
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Slower
Solubility in Water:	Completely soluble in all proportions.
Appearance:	Yellow liquid, nearly odorless

IV. FIRE AND EXPLOSION DATA

Flash Point:	None (Cleveland Open Cup)
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO ₂ , foam
Special Firefighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Conditions To Avoid:	None
Incompatibility (Materials To Avoid):	Oxidizing agents.
Hazardous Decomposition or Byproducts:	May release SO ₂ on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? No Skin? Yes Ingestion? Yes
Health Hazards (Acute and Chronic):	Skin contact may prove locally irritating, causing drying and/or chapping. Ingestion may cause discomfort and/or diarrhea.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Prolonged skin contact may cause drying and/or chapping.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs readminister fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. For small spills recover as much as possible with absorbent material and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	No special precautions in storing. Use protective equipment when handling undilute material.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Not Required
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are recommended.
Eye Protection:	Goggles and/or splash shields are recommended.
Other Protective Clothing or Equipment:	Not required
Work/Hygienic Practices:	Wash hands before eating, drinking or smoking.

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

MSDS**Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

MALLINCKRODT

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6668

Outside U.S. and Canada
Chemtec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYL ALCOHOL

MSDS Number: M2015 — *Effective Date: 12/08/96*

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol

CAS No.: 67-56-1

Molecular Weight: 32.04

Chemical Formula: CH₃OH

Product Codes:

J.T. Baker: 5217, 5370, 5794, 5807, 5811, 5842, 5869, 9049, 9063, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9893

Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE

LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.**J.T. Baker SAF-T-DATA^(tm)** Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 4 - Extreme (Flammable)

Reactivity Rating: 1 - Slight

Contact Rating: 1 - Slight

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD;
PROPER GLOVES; CLASS B EXTINGUISHERStorage Color Code: Red (Flammable)
-----**Potential Health Effects**
-----**Inhalation:**

A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.

Ingestion:

Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.

Skin Contact:

Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.

Eye Contact:

Irritant. Continued exposure may cause eye lesions.

Chronic Exposure:

Marked impairment of vision and enlargement of the liver has been reported. Repeated or prolonged exposure may cause skin irritation.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.

Skin Contact:

Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Flash point: 12C (54F) CC

Autoignition temperature: 464C (867F)

Flammable limits in air % by volume:

lcl: 7.3; ucl: 36

Flammable.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.

Fire Extinguishing Media:

Water spray, dry chemical, alcohol foam, or carbon dioxide.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer!

J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to

this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL

Hazard Class: 3

UN/NA: UN1230

Packing Group: II

Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL

Hazard Class: 3.2, 6.1

UN/NA: UN1230

Packing Group: II

Information reported for product/size: 350LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\----- Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes
-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-SARA 313-	
	RQ	TPQ	List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No
-----\Federal, State & International Regulations - Part 2\-----				
Ingredient	CERCLA	-RCRA-		-TSCA-
		261.33	8(d)	
Methyl Alcohol (67-56-1)	5000	U154	No	

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
 Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2PE

Poison Schedule: S6

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

Label Hazard Warning:

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

Label Precautions:

Keep away from heat, sparks and flame.
 Keep container closed.
 Use only with adequate ventilation.
 Wash thoroughly after handling.
 Avoid breathing vapor.
 Avoid contact with eyes, skin and clothing.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get

medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

New 16 section MSDS format, all sections have been revised.

Disclaimer:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Strategic Services Division

Phone Number: (314) 539-1600 (U.S.A.)

MSDS**Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

NITRIC ACID, 50-70%

MSDS Number: N3660 — *Effective Date: 12/08/96*

1. Product Identification

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 50%; Nitric Acid 65%; nitric acid 69-70%

CAS No.: 7697-37-2

Molecular Weight: 63.00

Chemical Formula: HNO₃

Product Codes: J.T. Baker: 5371, 5555, 5876, 9597, 9598, 9600, 9601, 9602, 9604, 9606, 9607, 9616 Mallinckrodt: 1409, 2703, 2704, 6623, V069, V077, V336, V561

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	65 - 70%	Yes
Water	7732-18-5	30 - 35%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 3 - Severe (Oxidizer)

Contact Rating: 4 - Extreme (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD;
PROPER GLOVES

Storage Color Code: Yellow (Reactive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:

Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion:

Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact:

Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact:

Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Chronic Exposure:

Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion:

Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc. Reacts with most metals to release hydrogen gas which can form explosive mixtures with air.

Fire Extinguishing Media:

Water spray may be used to keep fire exposed containers cool. Do not get water inside container.

Special Information:

Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand,

earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802. J. T. Baker NEUTRASORB(tm) or TEAM(tm) 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL): 2 ppm (TWA), 4 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 2 ppm (TWA); 4 ppm (STEL)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Colorless to yellowish liquid.

Odor:

Suffocating, acrid.

Solubility:

Infinitely soluble.

Specific Gravity:

1.41

pH:

1.0 (0.1M solution)

% Volatiles by volume @ 21C (70F):

100 (as water and acid)

Boiling Point:

122C (252F)

Melting Point:

-42C (-44F)

Vapor Density (Air=1):

2-3

Vapor Pressure (mm Hg):

48 @ 20C (68F)

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:

When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate.

Will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

Conditions to Avoid:

Light and heat.

11. Toxicological Information

Nitric acid: Inhalation rat LC50: 244 ppm (NO₂)/30M; Investigated as a mutagen, reproductive effector. Oral (human) LDLo: 430 mg/kg.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Nitric Acid (7697-37-2)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

 Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)

Hazard Class: 8

UN/NA: UN2031

Packing Group: II

Information reported for product/size: 150LB

International (Water, I.M.O.)

 Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)

Hazard Class: 8

UN/NA: UN2031

Packing Group: II

Information reported for product/size: 150LB

International (Air, I.C.A.O.)

 Proper Shipping Name: NITRIC ACID

Hazard Class: 8

UN/NA: UN2031

Packing Group: I

Information reported for product/size: 150LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	DSL	--Canada-- NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302- RQ	TPQ	-SARA 313- List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)

Nitric Acid (7697-37-2)
Water (7732-18-5)

1000
No

No
No

No
No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2PE

Poison Schedule: S6

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: Oxidizer

Label Hazard Warning:

POISON! DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

Label Precautions:

Do not get in eyes, on skin, or on clothing. Do not breathe vapor or mist. Use only with adequate ventilation. Wash thoroughly after handling. Keep from contact with clothing and other combustible materials. Do not store near combustible materials. Store in a tightly closed container. Remove and wash contaminated clothing promptly.

Label First Aid:

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

Mixture. New 16 section MSDS format, all sections have been revised.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: PENTANE

1. Chemical Product and Company Identification

BOC Gases,
Division of
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (908) 464-8100

24-HOUR EMERGENCY TELEPHONE NUMBER:
CHEMTREC (800) 424-9300

TELEPHONE NUMBER: (905) 501-1700

24-HOUR EMERGENCY TELEPHONE NUMBER:
(905) 501-0802

EMERGENCY RESPONSE PLAN NO: 20101

PRODUCT NAME: PENTANE

CHEMICAL NAME: Pentane

COMMON NAMES/SYNONYMS: Amyl hydride

TDG (Canada) CLASSIFICATION: 3

WHMIS CLASSIFICATION: B2, D2B

PREPARED BY: Loss Control (908)464-8100/(905)501-1700

PREPARATION DATE: 6/1/95

REVIEW DATES: 6/7/96

2. Composition, Information on Ingredients

INGREDIENT	% VOLUME	PEL-OSHA ¹	TLV-ACGIH ²	LD ₅₀ or LC ₅₀ Route/Species
Pentane FORMULA: C ₅ H ₁₂ CAS: 1096-65-0 RTECS #: RZ9450000	100	1000 ppm TWA	600 ppm TWA 750 ppm STEL	LC ₅₀ 364 gm/m ³ /4H (rat)

¹ As stated in 29 CFR 1910. Subpart Z (revised July 1, 1993)

² As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

3. Hazards Identification

EMERGENCY OVERVIEW

Vapors irritating to the eyes and respiratory system. Skin contact may cause irritation and dermatitis. Inhalation of vapors may cause dizziness, headache and nausea. High concentrations paralyze the central nervous system, causing loss of consciousness and respiratory paralysis. Vapors and liquid extremely flammable.

ROUTE OF ENTRY:

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion Yes
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PRODUCT NAME: PENTANE

HEALTH EFFECTS:

Exposure Limits Yes	Irritant Yes	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None Reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

EYE EFFECTS:

Vapors may cause mild irritation of the eyes.

SKIN EFFECTS:

Vapors may cause mild irritation and dermatitis to the skin.

INGESTION EFFECTS:

None expected.

INHALATION EFFECTS:

Inhalation of vapors may cause dizziness, headache and nausea. High concentrations paralyze the central nervous system, causing loss of consciousness and respiratory paralysis.

NFPA HAZARD CODES

Health: 1
Flammability: 4
Reactivity: 0

HMIS HAZARD CODES

Health: 1
Flammability: 4
Reactivity: 0

RATINGS SYSTEM

0 = No Hazard
1 = Slight Hazard
2 = Moderate Hazard
3 = Serious Hazard
4 = Severe Hazard

4. First Aid Measures

EYES:

Not specified. Seek medical attention.

SKIN:

Remove contaminated clothing as rapidly as possible. Flush affected areas with lukewarm water. DO NOT USE HOT WATER!

INGESTION:

Not normally required.

PRODUCT NAME: PENTANE

INHALATION:

Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area and given artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO PENTANE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

5. Fire Fighting Measures

Conditions of Flammability: Flammable liquid and vapor		
Flash point: - 40 °F (-40 °C)	Method: Not Available	Autoignition Temperature: Not Available
LEL(%): 1.5	UEL(%): 7.8	
Hazardous combustion products: Carbon monoxide, carbon dioxide		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: None		

FIRE AND EXPLOSION HAZARDS:

Flammable liquid and vapor.

EXTINGUISHING MEDIA:

Water (foam), dry chemical, carbon dioxide.

FIRE FIGHTING INSTRUCTIONS:

If possible, stop flow of pentane. Use water spray to cool surrounding containers.

6. Accidental Release Measures

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage**Electrical Classifications:**

Class 1, Group not specified.

Earth-ground and bond all lines and equipment associated with the system. All electrical equipment should be non-sparking or explosion proof.

PRODUCT NAME: PENTANE

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "NO SMOKING OR OPEN FLAMES" signs in the storage area or use area. There should be no sources of ignition in the storage or use area.

For additional recommendations, consult Compressed Gas Association's Pamphlet P-1.

8. Exposure Controls, Personal Protection

EXPOSURE LIMITS¹:

INGREDIENT	% VOLUME	PEL-OSHA ²	TLV-ACGIH ³	LD ₅₀ or LC ₅₀ Route/Species
Pentane FORMULA: C ₅ H ₁₂ CAS: 1096-65-0 RTECS #: RZ9450000	100	1000 ppm TWA	600 ppm TWA 750 ppm STEL	LC ₅₀ 364 gm/m ³ /4H (rat)

¹ Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

³ As stated in the ACGIH 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents.

ENGINEERING CONTROLS:

Use a laboratory hood with forced ventilation. Use local exhaust to prevent accumulation above the TWA.

EYE/FACE PROTECTION:

Safety goggles or glasses.

SKIN PROTECTION:

Use butyl rubber, PVC or polyethylene gloves.

RESPIRATORY PROTECTION:

Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

OTHER/GENERAL PROTECTION:

Safety shoes, safety shower, eyewash "fountain"

PRODUCT NAME: PENTANE

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Liquid	
Vapor pressure at 100 °F	: 15	psia
Vapor density (Air = 1)	: Not Available	
Evaporation point	: Not Available	
Boiling point	: 97	°F
	: 36	°C
Freezing point	: Not Available	
	: Not Available	
pH	: Not Available	
Specific gravity @ 70 °F	: 2.48	1 atm
Oil/water partition coefficient	: Not Available	
Solubility (H2O)	: Negligible	
Odor threshold	: Not Available	
Odor and appearance	: Colorless liquid and vapor with mild paraffinic odor.	

10. Stability and Reactivity

STABILITY:

Stable

INCOMPATIBLE MATERIALS:

Oxygen, other oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS:

None.

HAZARDOUS POLYMERIZATION:

Will not occur.

11. Toxicological Information

No chronic effects data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

12. Ecological Information

No data given.

PRODUCT NAME: PENTANE

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	N-pentane or Isopentane	N-pentane or Isopentane
HAZARD CLASS:	3	3
IDENTIFICATION NUMBER:	UN 1265	UN 1265
SHIPPING LABEL:	FLAMMABLE LIQUID	FLAMMABLE LIQUID

Packing Group: I

15. Regulatory Information

No data given.

16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

MSDS**Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

MALLINCKRODT

24 Hour Emergency Telephone: 908-659-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-562-2537) for assistance.

SODIUM HYDROXIDE

MSDS Number: S4034 — Effective Date: 03/05/97

1. Product Identification

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate

CAS No.: 1310-73-2

Molecular Weight: 40.00

Chemical Formula: NaOH

Product Codes: J.T. Baker: 3718, 3721, 3722, 3723, 3728, 3729, 3734, 3736, 5045,
5565 Mallinckrodt: 7001, 7680, 7708, 7712, 7772, 7798

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

**POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT.
REACTS WITH WATER, ACIDS AND OTHER MATERIALS.**

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

Inhalation:

Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.

Ingestion:

Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appear days after exposure.

Skin Contact:

Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.

Eye Contact:

Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.

Chronic Exposure:

Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:

Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard. Hot or molten material can react violently with water. Can react with certain metals, such as aluminum, to generate flammable hydrogen gas.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

- OSHA Permissible Exposure Limit (PEL): 2 mg/m³ Ceiling - ACGIH Threshold Limit Value (TLV): 2 mg/m³ Ceiling

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator.

WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

White, deliquescent pellets.

Odor:

Odorless.

Solubility:

111 g/100 g of water.

Specific Gravity:

2.13

pH:

13 - 14 (0.5% soln.)

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

1390C (2534F)

Melting Point:

318C (604F)

Vapor Density (Air=1):

> 1.0

Vapor Pressure (mm Hg):

Negligible.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:

Sodium oxide. Decomposition by reaction with certain metals releases flammable and explosive hydrogen gas.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Contact with water, acids, flammable liquids, and organic halogen compounds, especially trichloroethylene, may cause fire or explosion. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, tin, and zinc causes formation of flammable hydrogen gas.

Conditions to Avoid:

Moisture, dusting and incompatibles.

11. Toxicological Information

Irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe; investigated as a mutagen.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Sodium Hydroxide (1310-73-2)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8

UN/NA: UN1823
 Packing Group: II
 Information reported for product/size: 300LB

International (Water, I.M.O.)

 Proper Shipping Name: SODIUM HYDROXIDE, SOLID
 Hazard Class: 8
 UN/NA: UN1823
 Packing Group: II
 Information reported for product/size: 300LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Sodium Hydroxide (1310-73-2)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Hydroxide (1310-73-2)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302- RQ	TPQ	-SARA 313- List	Chemical Catg.
Sodium Hydroxide (1310-73-2)	No	No	Yes	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8 (d)
Sodium Hydroxide (1310-73-2)	1000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
 Reactivity: Yes (Pure / Solid)

Australian Hazchem Code: 2R
Poison Schedule: S6

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 1

Label Hazard Warning:

POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

Label Precautions:

Do not get in eyes, on skin, or on clothing. Do not breathe dust. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

Pure. New 16 section MSDS format, all sections have been revised.

Disclaimer:

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Prepared by: Strategic Services Division

Phone Number: (314) 539-1600 (U.S.A.)

5. If severe symptoms develop, make an incision and apply suction immediately. Apply a constricting band, if this has not already been done, and make a cut in the skin through the fang mark(s). Use a sharp, sterilized knife. Cuts should be 1/2 inch long, extending over the suspected venom deposit point. (Because a snake strikes downward, the deposit point is usually lower than the fang mark.) Cuts should be made along the long axis of the limb. Do not make cross-cut incisions. Do not make cuts on the head or trunk. Apply suction with a suction cup for 30 minutes. If a suction cup is not available, use the mouth. There is little risk to the rescuer who uses his mouth, but it is recommended that the venom not be swallowed and that the mouth be rinsed out.

If the hospital is not close, that is, if it cannot be reached in 4 or 5 hours, take the following measures:

- Keep trying to obtain professional care, either by transporting the victim to a place where medical care is available or by using an emergency communications system to obtain medical advice.
- If no symptoms develop, keep trying to reach the hospital and give the general first aid described above.
- If any symptoms at all develop, apply a constricting band, make incisions, and apply suction immediately, as described above in steps 4 and 5.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.
- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.

- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.
- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.
- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however, may be given. Consult a doctor or other medical personnel for specific medications that may be used.
- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

13.2 OTHER POISONOUS BITES

Spiders

Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (*Latrodectus Mactans*) and the Brown Recluse or violin spider (*Lox Osceles Reclusa*).

The symptoms of such a spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. Victims recover in almost all cases, but an occasional death is reported. The bite of a Black Widow spider is the more painful and often the more deadly of the two.

Field personnel should exercise caution when lifting covers off manholes or sumps or rummaging se spiders are typically found in these areas.

characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the chances of being bitten by a tick:

1. Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.
2. Wear light colored clothing so ticks can be easily spotted.
3. Wearing tick repellents may be useful.
4. Inspect clothing frequently while in tick habitat.
5. Inspect your head and body thoroughly when you return from the field.
6. Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin. Do not squeeze or crush it.

Rocky Mountain Spotted Fever

In the eastern and southern United States this tickborne disease is transmitted by the infected Dog Tick (*Dermacentor Variabilis*). It is important to note that the Dog Tick is significantly larger than the Deer Tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

Other Tickborne Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

13.4 POISONOUS PLANTS

Characteristic Reactions

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and a rash.

Some of the most common and most severe allergic reactions result from contact with plants of the Poison Ivy group including Poison Oak and Poison Sumac. The most distinctive features of Poison Ivy and Poison Oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

First Aid Procedure

1. Remove contaminated clothing.
2. Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.
3. Apply calamine or other soothing skin lotion if the rash is mild.
4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.